POWER

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PHILIP W. SWAIN, *Editor*

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PROSPERITY IS R.P.M.

• SWAMPED IN DETAILS, we sometimes forget what we're all after. Yet it's simple. We're after prosperity for the average citizen, and there's just one way to get it—through production.

• UNIVERSAL PROSPERITY means more than a fair division of wealth, important as that is. First of all it means plenty to divide.

• TAKE A PIECE OF PAPER and write down a fraction whose denominator is 125,000,000 people. In the numerator put all the clothes, food, machinery, services and luxuries America **produces.** This fraction equals all the average person can possibly get out of our economic system as it is now running. And this is the A.B.C. of practical economics.

• THE FRACTION WAS NEVER HIGH (compared with what it might be)—not even in 1929. There is no physical reason why America should not attain in a few years a much higher average standard of living than we have ever known, for the simple reason that our men and machines can obviously produce more per capita than we have ever consumed. We are not talking about money, but about **real** wealth—corned beef, cabbage, shoes, automobiles.

• WHEN THIS GOAL IS REACHED it will be through increased production; there is no other way under high heaven. As a nation, we consume just what we produce. What we **consume** is our standard of living. Hence per capita production equals standard of living.

• HERE IS A FACT any engineer can hang his hat on even if he doesn't understand "all about economics" (as nobody else does, either).

• WE DON'T NEED TO ARGUE that the economic machine is jammed, that the production numerator of the prosperity fraction is pretty sick. Everybody knows it, although the patient seems to be convalescing.

• BECAUSE WE HAVE DEVELOPED a complex economic life—involving credit, banking, stocks, bonds, debts, mortgages—half the experts in the country are staying up nights untangling the financial and legal haywire that has snarled our productive machinery. That is their job—the haywire. Ours is the machine inside, which we engineers designed, built and can operate for the direct satisfaction of human needs.

• SO WE, AS ENGINEERS, can always enter the economic council rooms with these questions on our lips. "Gentlemen, will your plans clip the wire that stalls our machines? We're set to go; will you let us? Prosperity is R.P.M."

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• THE FOREGOING WAS WRITTEN October 22. As if in answer to the maiden's prayer, next morning's newspapers carried this headline: "NRA Board Decides to Cease Curbing Industry Output." And then: "Prices are to be lowered by permitting mass-production plants to operate at capacity, thus reducing unit costs. Increased demands will cause manufacturers to take on more laborers to produce goods. Increasing competition will cause prices to stiffen at the same time as employment is increasing and new consumers are being brought into the market."

NOTHING BUT AIR

AIR CONDITIONING comes fast. Engineers everywhere call for information and *Power* publishes many articles on the subject, though chiefly on special systems or installations. Now we start over again. We propose to eliminate the "mystery" of air conditioning.

The only hard thing about air conditioning is the jargon. To prove it *Power* presents this month (page 604) a "first reader" of air conditioning so simple that it makes one wonder what all the shouting's about. Just a matter of air, water, heat, cold—and dirt. And nothing more than the same old equipment the power engineer has always known: pumps, sprays, fans, filters, coils. Add a knowledge of how air carries water, and of the types and combinations of units, and you are an "air conditioning engineer."

It may be giving the whole game away, but *Power* will follow up this month's A-B-C with the C-D-E of actual air conditioning equipment items and their combinations. Better watch this series!

PICTURES PAY

"ONE picture is worth a thousand words." If you freeze today into a picture you can see the past tomorrow. A photo film is a perfect memory. And a perfect memory is worth money when you face a drawing board, a lawsuit, or an ailing machine.

Executives of large plants (notably central stations) know this and are willing to pay the keep of a photo staff. The small industrial plant can get the same service, as far as it is needed, by a trivial subsidy to some amateur photographer in the gang. Just supply him with camera and photo-flood lights that he can leave at the plant and allow him a small supplies budget (or a fixed price per film and print ordered). One hundred dollars will cover the entire outfit including filing cabinets. See page 608.

If any reader has questions about suitable equipment or correct procedure, *Power* will be glad to pass along the advice of its own photo laboratory.

WELDING IS SAFE

THOSE who attended the recent fall meeting of the American Welding Society (see page 620) came away more than ever convinced that welding is the greatest mechanical tool of this mechanical age.

Many power engineers recognize this fact, but the welding of high-pressure steam lines has lagged from lack of complete confidence.

It may be that neither you nor your own force knows just how to insure an absolutely safe welding job, but the necessary men, materials, processes and testing procedures are available today, thanks largely to the progressive efforts of the A.W.S. Somebody, somewhere, can do that welding job, however difficult, and do it right.

POWER PENNY

THOUSANDS of engineers keep power cost records. Many of their systems are elaborate, well maintained, constantly studied and *used*. The cost idea has sunk home.

It's a great start, saving industry thousands of dollars every day, but the end is not yet. We need more agreement on cost-keeping fundamentals, so that one engineer will accept without argument the records of another, so that management will accept the records of both as demonstration of good performance or ample proof of the need for plant alterations.

This is no easy job, but a group of engineers is working on it with full recognition of the problems of every-day plant operation. *Power* is in close touch with this work and expects to report progress from time to time in these pages.

POWER EXECUTIVES

"PLANT Engineer"—"Power Engineer"—"Chief Engineer"—"Supervisor of Power." There are plenty of titles to describe the job, but the typical industrial establishment has some one man who must *manage* men, money, and machines to deliver high quality power services at the lowest possible cost.

In a group of six special articles, December *Power* will bring these men the best thinking of other industrial power executives—engineers of recognized standing and long experience. They will deal with top problems of power management; handling men, operation, maintenance, costs, growth and change.

POWER STANDS FOR

1. Making power when it should be made
2. Buying power when it should be bought
3. Cheaper power through modern equipment
4. Easier financing of equipment purchases
5. Better use of by-product heat and power
6. Operating methods that save money
7. Less waste in transmission and application
8. Prevention of smoke, within reason

Minnesota's largest brewery builds new power house and modernizes power - service equipment. Annual savings will be over $57,000 with production up 25 per cent

THIS PLANT WILL PAY OUT IN 4 YEARS

Steam is supplied by three 4,750-sq. ft. boilers at 300 lb. gage and 600 deg. total temperature

THEO. HAMM Brewing Co., St. Paul, largest brewery in Minnesota, has a capacity of 2,800 barrels per day. When the Eighteenth Amendment was repealed, this company's power equipment was both inadequate and out of date. Study indicated that the only solution was complete modernization.

Steam was generated at 125 lb. pressure in six h.r.t. boilers and two water-tube boilers of old designs. About 50 tons of coal per day were required, and this was handled by hand, even being shoveled from the cars. Part of the brewery was supplied with power from a steam engine and an antiquated mechanical-power-transmission system, the latter extending through several floors of the main building and into adjacent buildings. Most of the process and other pumps were driven by steam. Except for a small part used for water heating, all exhaust was discharged to atmosphere, high-pressure steam being used for cooking.

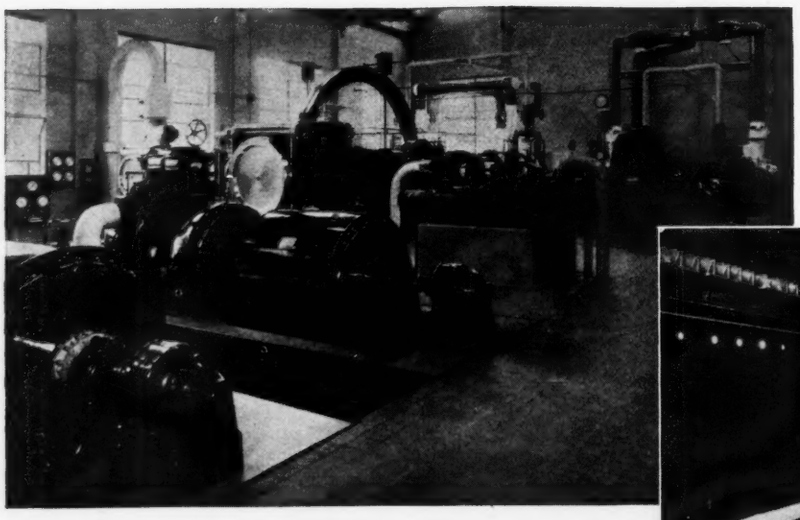
There was also a steam-driven refrigerating plant that included one 350-ton cross-compound, corliss-engine driven and three smaller compressors. When prohibition became a law, the refrigerating equipment was converted into an ice-making plant and the company developed a permanent ice business of 200 tons per day. With the return of beer, refrigerating capacity was insufficient to supply both the ice-making and brewery loads. There was no reason to drop the ice business, so the ice plant had to be enlarged. Power was also purchased from the local power company for lighting and to drive part of the plant. The plant power system was in bad condition and required complete overhauling.

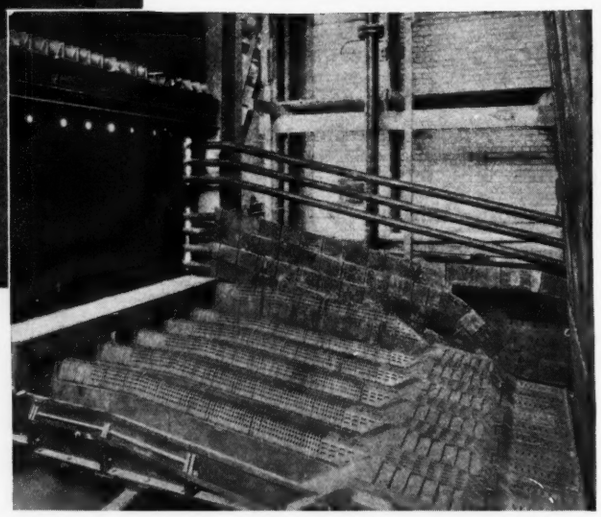
It seemed best to modernize the power and other services and to make them adequate for present and future requirements. This required a new power plant and junking a large part of the old equipment without interfering with the manufacturing processes, at the same time electrifying and modernizing all production equipment.

Design New Power Plant

A new power plant, separate from the manufacturing buildings, was designed to house the steam-making, power-generating and refrigerating equipment. A new 400-ton synchronous motor-driven refrigerating unit was installed in the new power plant. After this was in service the 350-ton steam machine was moved from the old to the new plant during winter when the refrigerating load was comparatively small. A surface condenser was installed on this engine. With the exception of this large steam-driven compressor, all old refrigerating equipment was sold.

To supply steam, three 4,750-sq.ft. vertical water-tube boilers were installed. These are designed for 300-lb. gage working pressure, operate at 280 lb. and are stoker fired. As can be seen from the drawing, the boiler settings are a low headroom design with furnaces in front. Boilers are equipped with superheaters in the first pass to give a total steam tempera-





Left—Power plant contains two 1,250-kva. turbine-generators, a 350-ton steam-engine driven and a 400-ton synchronous-motor driven ice machine. Below—Furnace side walls above the stoker are protected by water walls seven tubes high

ıure of 600 deg. F. Along the fuel-bed line the furnace sidewalls have refractory covered waterwalls, seven tubes high. The four lower tubes are armor-clad, the three upper tubes covered with C tile. These tubes connect into the mud drum, which is 42 in. in diameter, and extend to the two vertical legs of an inverted U header outside the furnace. The horizontal section of this header is connected to the front steam drum by a row of tubes forming a water-cooled roof for the furnace.

The stokers are of a new underfeed type having six retorts arranged for rear-end cleaning, with steam-powered dump and control of fuel movement in each retort. Rams are rectangular in cross-section and have adjustable wearing side plates. They are designed for 250 per cent boiler rating but have operated up to 400 per cent.

At the back of each boiler is a tubular air heater arranged for gas flow inside and air flow outside the tubes. Heated air passes down into a duct under the basement floor and goes to the forced-draft fan at the furnace front.

Tall Stack Necessary

These boilers operate on natural draft supplied from a reinforced-concrete, radial-brick-lined stack 290 ft. high. Because the plant is on comparatively low land and the surrounding high ground is a residential section, a tall stack was necessary to insure that fumes and cinders would not become a public menace. It was made high enough to operate four boilers with air heaters at 300 per cent rating without induced-draft fans. Air-heater bypasses with dampers have been provided so that in very hot weather part of the gases can be bypassed if necessary.

Combustion air is supplied by forced-draft fans to the stokers at 300 deg. F. Stokers are steam-engine driven and fans are driven by wound-rotor motors, the latter to give 50 per cent speed control. Automatic control is provided for each boiler, and the three boilers may be operated from one master regulator. In this system the master regulator consists of what is essentially a slide-wire bridge operated from steam pressure. A change in steam pressure causes the slide on the bridge to take a new position, which in turn starts a fuel and air proportioning motor. On the shaft of this motor is a contact for fuel control and a contact for combustion-air control to each boiler.

Forced-draft fan speed is adjusted manually to approximately load requirements from the boiler control panel. Exact adjustment of air flow is then made automatically by the combustion-control system regulating dampers in the forced-draft fan discharge. Stoker engine speed is automatically controlled by opening and closing the throttle valve. Furnace pressure is maintained constant at about —0.1 in. of water by an automatic regulator controlling damper position in the air-heater outlet. By turning a single knob on the boiler-control panel the boiler attendant can adjust the fuel-air ratio to maintain any desired CO_2 in the flue gas. This combustion-control system, although not completely automatic, is simple and, except for an occasional adjustment of fan speed, relieves the boiler attendant of a large part of the responsibility of maintaining correct steam pressure and efficient operation.

Coal, received in cars, is dumped to a track hopper and is elevated and delivered to an overhead bunker by a bucket conveyor. From here the coal is weighed into the stoker hopper of each boiler by a weigh larry.

Boiler Control Boards

A boiler-control board is provided for each boiler. On this board are assembled a 3-point draft gage; steam-pressure gage; boiler-load indicator, steam-flow recorder and integrator; meter recording air temperatures under the stoker, gas temperature leaving the air heater, total steam temperature and per cent CO_2 in flue gas; automatic combustion control; manual control for the forced-draft fan, and as previously mentioned, a fuel-air-ratio adjustment for the automatic combustion control. From this board the attendant has complete control of the boiler and an indication of its performance so that adjustment may be intelligently made to maintain high operating efficiency. Success of the equipment is indicated by the high average boiler and furnace efficiency, 83 per cent, that is maintained even under widely fluctuating loads.

Power is generated by two 1,250-kva. turbine-generators. One of these units has sufficient capacity to carry the present electrical load, so that the plant has 100 per cent spare capacity. This is considered necessary because the process is continuous 24 hr. per day, making it necessary that when a machine is taken out of service another unit of equal capacity be available to take its place. The turbines are arranged to bleed at 60 lb. gage pressure for process and cooking and exhaust to surface condensers.

Condensing water is supplied from deep wells. This water first passes through the ammonia condensers in the refrigerating plant, then through the surface condensers on the turbine-generator and the steam engine driving the 350-ton ice machine. This water then goes to a storage tank for service purposes. Excess water above that required for service runs to waste. From this it is seen that all the water is used at least three times and part serves four purposes. This was one of the reasons why condensing turbines were desirable. Water had to be pumped for the ammonia condensers, so that its use in the turbine condenser is obtained at practically no cost.

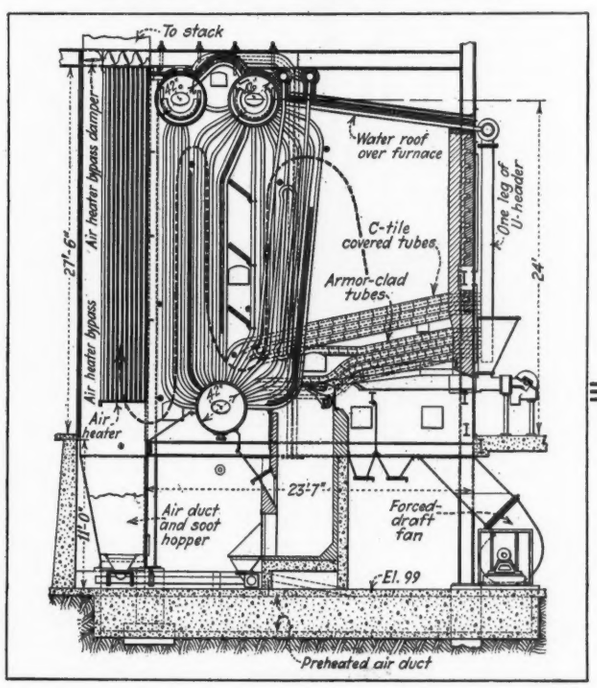
Electrical System

Power is generated at 4,000 volts, 3-phase, 60 cycles. This voltage was selected because it corresponded to that at which power was purchased. It therefore allowed the change from one system to another at a minimum cost. By using fairly high-speed motors and not overmotoring the drives when electrifying the brewery, a power factor of over 80 per cent was obtained for the load. The 600-hp., 80-per-cent leading-power factor synchronous motor driving the 400-ton ice machine maintains unity power factor at the power-house busbars.

The 350-ton ice-machine engine operates at 125-lb. gage pressure, that of the old boiler plant and is supplied from the 280-lb. header through reducing valves. On its low-pressure side a large receiver tank is connected to relieve the reducing-valves of pressure changes because the engine takes steam intermittently. A reducing valve is also connected between the 125-lb. and 60-lb. lines so that if for any reason sufficient steam is not obtained from the turbine bleed connection it will be supplied through the reducing valve.

Steam and electric meters have been provided so that steam and power distribution may be determined and

Water-wall and roof tubes connect to an inverted U header at the front of the furnace



Principal Equipment in Power Plant

Boilers and Auxiliaries

Boiler, superheaters and air-heaters. Wm. Bros Boiler & Mfg. Co. Number, 3; boiler heating surface including water wall, sq.ft., 4,750; max. steaming capacity, lb. per hr., 45,000; gage working pressure at boiler drum, 300 lb.; superheater surface, sq.ft., 590; total steam temperature, deg. F. 600; furnace volume, cu.ft., 1,725; max. B.t.u. liberated per cu.ft. per hr., 30,000; air-heater surface, sq.ft., 5,160; gas temperature entering air heater, deg. F., 560; gas temperature leaving air heater, deg. F., 375; air temperature leaving air heater, deg. F., 300.
Breechings ..... Wm. Bros Boiler & Mfg. Co.
Stack ..... Alphons Custodis Chimney Constr. Co.
Refractories ..... Laclede-Christy Co.
Boiler settings ..... Michael Liptak
Armor blocks on water walls, Drake Non-Clinkering Furnace Block Co.
Water columns ..... Reliance Gauge Column Co.
Feedwater regulator (Copes) ..... Northern Equipment Co.
Feedwater regulators ..... Stets Co.
Continuous blowdown ..... Permutit Co.
Soot blowers ..... Vulcan Soot Blower Co.
Blowoff valves ..... Wm. Bros Boiler & Mfg. Co.
Safety valves ..... Crane Co.
Safety valves, superheaters .. Consolidated Ashcroft-Hancock Co.
Non-return valves ..... Walworth Co.
Coal bunker ..... Wm. Bros Boiler & Mfg. Co.
Coal-handling equipment ..... Link-Belt Co.
Coal weigh larry ..... Link-Belt Co.
Scale ..... Fairbanks Morse & Co.
Ash-handling equipment ..... United Conveyor Co.
Automatic combustion control, Minneapolis-Honeywell Regulator Co.
Stokers (underfeed) ..... Detroit Stoker Co.
Stoker drive, engine ..... Troy Engine & Machine Co.
Forced-draft fans, 1 per boiler ..... Buffalo Forge Co.
Fans driven by 40-hp. Westinghouse slip-ring motors arrange for 50 per cent speed control
Deareating feedwater heater ..... Hoppes Mfg. Co.
Feedwater treatment ..... Permutit Co.
Boiler feed pumps, 2, one turbine-and one motor-driven, Worthington Pump & Mach. Corp.
Boiler feed-pump turbine ..... General Electric Co.
Boiler feed-pump motor ..... General Electric Co.

Turbines and Auxiliaries

Turbine-generators, two, 1250-kva., 0.80 p.f., 3,600 r.p.m. direct-connected exciter, turbines bleed at 60 lb. gage, exhaust 1 in. hg abs. ..... General Electric Co.
Condensers ..... Worthington Pump & Mch. Corp.
Hotwell pumps ..... Worthington Pump & Mch. Corp.
Steam ejector vacuum pumps .. Worthington Pump & Mch. Corp.
Oil filter ..... S. F. Bowser Co.
Crane, 10 ton ..... Shaw Box Crane & Hoist Co.
Switchboard ..... Commonwealth Electric Co.
Switchboard equipment ..... General Electric Co.
Oil switches ..... General Electric Co.
Transformers ..... General Electric Co.

Piping, Valves, Meters

Desuperheater control ..... Hagan Corp.
Reducing valves ..... Boylston Steam Specialties Co.
Atmospheric relief valves .... Worthington Pump & Mach. Corp.
High-pressure valves ..... Walworth Co.
Low-pressure valves ..... Walworth Co.
Electric valve operators ..... Cutler-Hammer, Inc.
Traps ..... Strong, Carlisle & Hammond Co.
Piping ..... Crane Co.
Pipe covering ..... G. A. MacArthur Co.
Boiler meter board ..... Minneapolis-Honeywell Regulator Co.
Steam flowmeters ..... Brown Instrument Co.
Feedwater meter ..... Brown Instrument Co.
Water flowmeters ..... Brown Instrument Co.
Steam-load indicators ..... Brown Instrument Co.
CO_2 recorder ..... Brown Instrument Co.
Temperature recorders ..... Brown Instrument Co.
Pressure and temperature indicators ..... Foxboro Co.
Pressure gage ..... Jas. P. Marsh Corp.
Draft-gages, indicating ..... Ellison Draft Gage Co.
Vacuum gages ..... Precision Thermometer & Instrument Co.
Thermometers, indicating ..... C. J. Tagliabue Mfg. Co.
Recording pyrometer ..... Brown Instrument Co.

Pumps

Deepwell pumps ..... Peerless Pump Div.
Deepwell pumps ..... Worthington Pump & Mach. Corp.
Deepwell-pump motors ..... General Electric & Westinghouse
Sump pumps ..... Nash Engineering Co.
Ice machines ..... Filter Mfg. Co.
Compressor motor, 600 hp. synchronous Electric Machinery Mfg. Co.

charged to departments using them. Three flowmeters are provided on each turbine: one for total steam, one for bleed steam and one for condensate. Flowmeters are also provided to determine distribution of the 60-lb. steam to the important services and high-pressure steam to the steam-engine-driven ammonia compressor. Feed water and water from the wells are also metered.

Records of operation of the old plant are not available, so a direct comparison cannot be made with the new plant. There are, however, certain large savings that can be determined. The new plant generating all the power burns approximately 2,500 tons of coal per year less than the old plant, a saving of about $12,000 per year. About 135 tons more ice are made per day now than in the old plant, and the output of the brewery is about 25 per cent greater. All water is now pumped from wells, while previously a large part of it was purchased from the city at an average cost of $11,000 per year. Formerly $24,000 per year was paid for purchased power. The saving in labor cost will be about $10,000 per year. In addition, maintenance and other costs have been reduced and plant reliability increased.

From the foregoing it is seen that the savings are large. They are estimated to be sufficient to pay for the new plant in about four years.

Design and construction of the plant was carried out under direction of W. H. Lang of the Theo. Hamm Brewing Co. The equipment and piping layout was made by Albert Buenger, mechanical engineer of the firm of Clarence H. Johnston, architects for the project. Operation of the plant is in charge of T. W. Konkle, chief engineer.

Effect of Preheat on Stoker Operation

BULLETIN 378 of the Bureau of Mines (obtainable for 10 cents from the Superintendent of Documents, Washington, D. C.) is a good example of a piece of scientific research leading to important practical conclusions. P. Nicholls, author of the bulletin, reports the results of an extended investigation on the underfeed firing of solid fuels with various rates of air flow and various degrees of air preheat. It is not possible to summarize this 78-page bulletin in the space here available, but some general conclusions will be of interest to all who are concerned with the use or manufacture of stokers or air preheaters. These follow, in our own language.

With overfeed firing, the rate of ignition puts no limitation upon how much fuel can be burned per square foot per hour. As air flow is increased to consume more and more coal per hour, the rate of ignition with the overfeed firing increases even more rapidly. In short, extreme draft cannot blow the fire out, unless it actually lifts the solid fuel from the fuel bed.

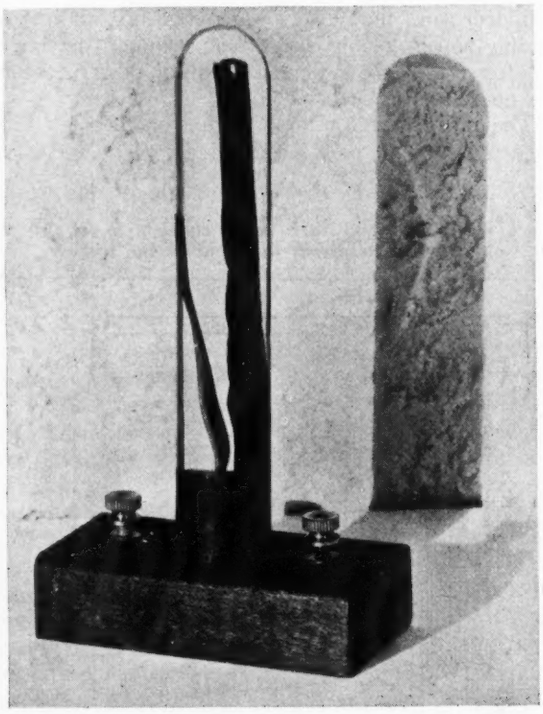
With underfeed firing, ignition has to strike downward, in a direction opposite to the flow of air and of fuel. Starting with a low combustion rate, increased air flow increases the ignition rate as well as the combustion rate. For a while ignition keeps out of the way as a limiting factor, so that more air burns more coal. However, with each type and size of fuel, an air velocity is reached beyond which the ignition rate becomes less than the possible burning rate and thus limits the fuel burning capacity. If the air flow is raised high enough, the ignition rate will fall to a point where combustion cannot be maintained. There is some air rate at which the rate of ignition reaches a maximum and thus fixes maximum rate combustion.

Now one of the significant conclusions of the investigations is that the ignition rate is substantially increased by preheating the air. It has, of course, been known for some time that air preheat increases the capacity of underfeed stokers, but the investigation makes more clear just why this is so.

The investigations also show how preheat affects an overfeed bed; for a given rate of combustion and thickness of fuel bed, it increases the ratio of secondary to primary air required to give the same CO_2 in the flue gas, and only part of the preheat appears as an increase in the sensible heat of the gases from the fuel bed.

The bulletin also develops some ideas that will be new to most on the distribution of ash in fuel beds and shows the large difference in this respect between underfeed and overfeed beds. A piece of fuel will take several times longer to pass through—that is, to be completely burned in—an underfeed bed of the same thickness and with the same rate of burning.

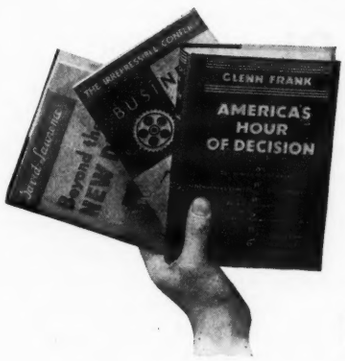
LIKES SUNSHINE



THE ENGINEER who likes to "play around" with new things will enjoy experimenting with this photo-voltaic cell which can be bought for 35 cents or made for less. Parts are a test tube, electrodes of lead (center) and oxidized sheet copper, base, cork and 2 binding posts. Copper is oxidized by passing it over a blue-flame bunsen burner. The tube contains water and a few drops of nitric acid. Exposed to sunlight, this little gadget will throw the needle of a galvanometer. In the dark it goes dead. Liquid and electrodes last indefinitely.

NEW DEAL or NEW DECK?

Three Aces Discuss National Economics



A Review By
PHILIP W. SWAIN
Editor of POWER

BEYOND THE NEW DEAL (1934)—*By David Lawrence, Editor, "The United States News." Published by Whittlesey House, McGraw-Hill Book Co., 330 West 42nd St., New York, N. Y. 321 pages, 6 x 9 in. Cloth covers. Price $2.50.*

AMERICA'S HOUR OF DECISION (1934)—*By Glenn Frank. Published by Whittlesey House, McGraw-Hill Book Co., 330 West 42nd St., New York City, N. Y. 263 pages, 5½ x 8½ in. Cloth covers. Price $2.50.*

THE presses grind fast these days, but no faster than the affairs discussed in the economic books they turn out, particularly those that talk about the New Deal. Lawrence's book was published Sept. 13, Frank's Oct. 15. Both are notable jobs, full of concentrated thought. And they will be read, for most of America's 125,000,000 inhabitants are today interested in economic problems and some thousands are capable of following the arguments presented.

Good advice to anybody studying today's political and economic problems is this: Keep your shoes on the ground; don't be swept off your feet by any single book or article or editorial. If you read enough articles and books and do enough thinking of your own, you will, in this reviewer's opinion, come to the conclusion that the extremists in both radical and conservative camps are blind to certain inescapable facts. The only safe course lies in a fresh study of all the facts, with all preconceived notions held in leash.

If you read Lawrence's book first, you will finish it pretty well convinced that we must right-about-face on practically every trend of today's government. In particular you will view with great alarm mounting governmental expenditures and the higher taxation they must sooner or later produce. You will acquire a deadly fear of regimentation and political super control.

If next you read "Business Versus Finance," the book which David Cushman Coyle wrote several years ago, you may right-about-face on the tax matter. However, after reading Coyle's book you will still feel that too much political control—too much bureaucracy and too much regimentation—is a real danger.

Then, let's say, you read Frank. Here is still a different approach. The three books are as fundamentally different as are their three authors. Lawrence is an old-time Washington journalist, with vast knowledge of government affairs and intrigues, and a strong conservative leaning. He writes like a lawyer making a case for a client—which is certainly not the New Deal, although he grants it a little here and there.

Coyle is the consulting engineer with views any financier would consider "unsound." He fights *for* "business" and *against* "finance." He marshals his arguments with great skill and force (as does Lawrence). His book antedates the New Deal and is therefore neither for nor against it, but he certainly is not for the Old Deal.

Glenn Frank, distinguished president of the University of Wisconsin, also fights for his ideas. Like the other two, he has drive as well as intellect, but, in the opinion of this reviewer, he takes the decision over both of them. Compared with Lawrence, Frank seems more disinterested, less partisan. Compared with Coyle, he seems (perhaps because his book is larger) to have a bigger grasp of all the factors involved. Frank in the past has been looked upon by some as rather radical, yet he is distinctly conservative in his passionate unwillingness to chuck overboard any factor in the American tradition that is workable and has honest value. In "America's Hour of Decision," he appears just as vigorous a foe of "regimentation" as is the *Saturday Evening Post,* and as vigorous a defender of the virtues of individual initiative, untrammeled by governmental red tape. But on one point he stands at the very opposite pole. He views the traditional "conservative" political stand, the attempt to turn the clock back to 1928, as the last word in damfoolishness. In his opinion, elaborately backed by reasons, such a course would be disastrous to the very groups that are urging it most violently—the reaction from its unworkability would smash all they hold most dear.

Frank's book is in no sense a campaign document. It deals rather with the basic philosophy of statesmanship in an age of plenty. We must find a way, he says, to release the productive energies of the American people, to utilize to the utmost our individual genius for getting things done. To do this we must change some of the machinery of government, because it is not fitted to a power age—grew up under utterly different conditions to which it was suited. But we must *not,* under any circumstances, says Frank, freeze life into a pattern and try to be happy merely by sharing the crumbs of a low total of national income. Even the 1929 national income, he asserts, was neither adequate nor equal to our productive capacities.

It is unwise today for any business man or engineer to form his opinions on matters of public policy entirely from what he reads in his favorite magazines and newspapers. He should go a little deeper. He should read a few books that have perspective and honesty. If he does this he will be less likely to join the crowds that today throng the cheering section and the wailing wall.

SELECT THE RIGHT TURBINES
For Your Industrial Power Plant

By ROLAND S. FITCH, M.E.
Ballinger Co.,
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EXPENDITURES for economy-producing equipment in an industrial power plant can only be justified when return on the investment is not surpassed by return from a similar expenditure on manufacturing machinery. Simplicity should be uppermost in industrial power-plant design, because management seldom employs the highly trained personnel necessary to operate a complex plant. Plant embellishment should be avoided, and generally the plant should be designed for more conservative efficiency than calculations might seem to indicate.

It is not my intention to discuss here the reasons for arriving at a decision to generate power, but rather to show by concrete examples how turbine size and type are determined to meet specific conditions.

Know Basic Facts

Certain basic facts must be known before a prime mover may be selected. These are: (1) total electrical demand, (2) total process steam demand, (3) hourly and seasonal variations in electrical and process steam load, (4) minimum process steam pressure, (5) initial pressure available or selection of pressures to satisfy all contingent conditions.

In plants where by-product power is to be generated, the turbine is the keystone of the design. To illustrate how different combinations of different sizes and types might be applied to the problem, the following examples are given, together with reasons for the particular combination adopted, and for discarding the others.

The manufacturing plant for which this power plant was designed requires process steam at 165 lb. pressure and 425 deg. The amount of process steam required averages 120,000 lb. per hour daily, but at times a peak demand of 145,000 lb. of steam an hour is required.

Average daily electrical load is 6,000 kw., with a night load of 2,800 kw. Peaks of 7,500 kw. should be provided for. A certain part of the day load may be dropped, but not below 4,800 kw. Due to the character of the manufacturing process, part of the load can be dropped in an emergency, but 4,800 kw. must be kept available for factory consumption at all times during the day.

The steam pressure decided upon was 400 lb. at the turbine throttle and 100 deg. superheat, or a steam temperature of 515 deg. With this initial temperature the 165-lb. pressure steam, if bled from a turbine, would be superheated only about 30 to 40 deg., higher superheat than this not being desirable for this particular process

From a heat-balance point of view it is evident that a straight back-pressure turbine should be given first consideration. All of the exhaust steam from such a turbine is available for process. The steam rate under these conditions and this high back-pressure would be about 65 lb. per kw.-hr. Since 120,000 lb. of steam per hour is required to satisfy average process requirements of the factory, only about 1,850 kw. can be generated, unless exhaust steam is lost to atmosphere. But the total maximum power demanded of the power plant is 7,500 kw. To supply the additional electrical load and the 25,000 lb. of steam per hour needed when the process steam demand is 145,000 lb. per hour, a bleeder condenser turbine can be installed. To insure reliability and standby service, a third unit seems desirable. This may be a bleeder condensing unit or a straight condensing unit to take advantage of improved steam rate.

Type and size of turbines selected to meet these specified conditions were: one 3,000-kw. bleeder condensing unit, bleeding a total of 60,000 lb. of steam an hour at 165 lb. pressure and 40 deg. superheat, one 3,000-kw. condensing unit, and one 1,500-kw. back-pressure unit exhausting at 165 lb. gage and 32 deg. superheat. Steam consumptions for these turbines are shown in the curves, Figs. 1, 2 and 3. Steam consumption of the condensing unit is based on a vacuum of 27½ in. secured by a surface condenser. The 3,000-kw. condensing unit was decided upon because it costs $3,000 less than the bleeder type and has a lower steam rate.

Total Steam

Assuming an average load of 6,000 kw., and 120,000 lb. of process steam per hour, the total steam to the turbine throttle will be as shown by the following tabulation:

	Steam Rate	Steam Bled, lb. per hr.	Steam at Throttle, lb. per hr.
1—1,500 kw. back-pressure unit. Load at 1,500 kw.	65.5 lb.	98,250	98,250
1—3,000-kw. bleeder condenser unit. Load at 2,250 kw.	.....	21,750	49,500
1—3,000-kw. condensing unit. Load at 2,250 kw.	13.1 lb.	.....	29,475
Total		120,000	177,225

With this arrangement of turbines, the back-pressure unit will always be in operation during the day at its total capacity of 1,500 kw., and hence there will be 98,000 lb. of process steam available. Where the demand for steam is as great as in this case, the back-pressure unit is more economical in operation than bleeder types.

At night, when the load is 2,800 kw. and 55,000 lb. per hour of process steam, the 3,000-kw. bleeder con-

densing unit will be in operation, and will carry the load with a total steam flow of 82,000 lb. per hour at the throttle. The base load of 4,800 kw. can be met when any one turbine is off the line. This is an important feature of this set-up. With the 1,500-kw. unit down, 5,000 kw. can be carried, 60,000 lb. of steam per hour being bled. The remaining 60,000 lb. of process steam can be obtained through reducing valves from the boiler. The reducing valves should only be in operation in emergencies, and when one unit is down, or if electrical demand decreases. When one 3,000-kw. unit is down the other units will carry 4,800 kw. at a slight overload.

Several other similar sizes and types of turbines were considered before making the above selection, but they closely approximate the final size and type of turbine selected in steam rate and first cost. The second combination was two 3,500-kw. bleeder condensing units, each bleeding a total of 60,000 lb. of steam an hour at 165 lb. pressure. Assuming the average load of 6,000 kw. and 120,000 lb. steam per hour the condition existing would be as shown in the following tabulation:

	Steam Bled, lb. per hr.	Steam at Throttle, lb. per hr.
1—3,500-kw. carrying 3,000 kw	60,000	89,000
1—3,500-kw. carrying 3,000 kw	60,000	89,000
Total	120,000 lb.	178,000 lb.

One turbine will meet the night load conditions carrying 2,800 kw., and bleeding 55,000 lb. per hour to process, but one of these units cannot meet the base load of 4,800 kw., and the total capacity would be approximately only 7,000 kw.

The third arrangement considered comprised three 2,500-kw. bleeder condenser units, each bleeding 60,000 lb. per hour at 165 lb. pressure. Assuming the average load of 6,000 kw. at 120,000 lb. per hour of process steam, the condition existing would be:

	Steam Bled, lb. per hr.	Steam at Throttle, lb. per hr.
1—2,500-kw. bleeder condenser carrying 2,000 kw..	60,000	78,500
1—2,500-kw. bleeder condenser carrying 2,000 kw..	60,000	78,500
1—2,500-kw. bleeder condenser carrying 2,000 kw..	.....	29,000
	120,000 lb.	186,000 lb.

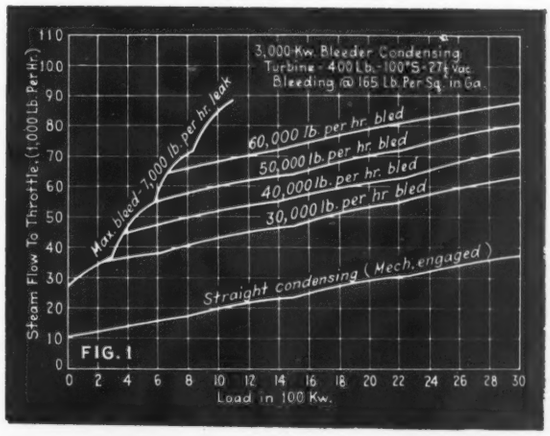
With three units in operation, the average daily load is easily carried, and if one unit is down the two remaining units can carry the base load of 4,800 kw. With the three units in operation, there is sufficient capacity to carry the peak load of 7,500 kw. However, the night load of 2,800 kw. would be a continuous 12 per cent overload for 16 hr. on one unit. Heat generated by the continued overload would tend to deteriorate the insulation and shorten the life of the generator winding. Therefore, two units at lower efficiency would have to operate to carry the night load satisfactorily. With two units operating, the steam consumption for night load conditions would be:

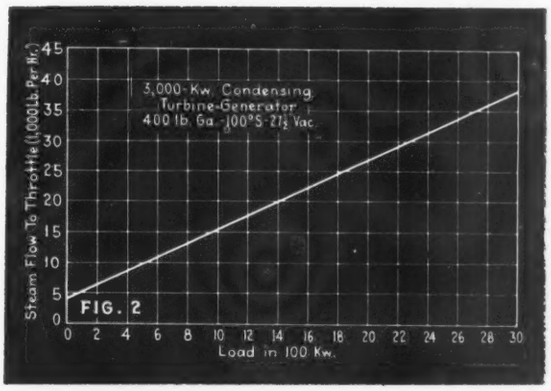
	Steam Bled, lb. per hr.	Steam at Throttle, lb. per hr.
1—2,500-kw. unit carrying 1,400 kw	55,000	68,000
1—2,500-kw. unit carrying 1,400 kw	.....	22,410
	55,000 lb.	90,410 lb.

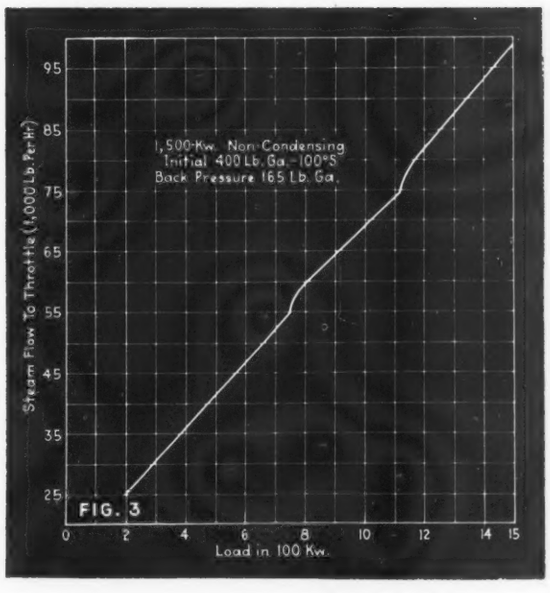
Two 5,000-kw. bleeder condensing units would meet all the required conditions, and can be regulated to operate efficiently for the 16-hr. night load. However, the total output would be far in excess of the maximum load required, and the first cost of these units is quite high.

A summary of the four arrangements considered, showing the first cost of the turbines, condensers and auxiliaries, including delivery and erection, steam consumption during average day load, and steam consumption during night load conditions, is given in the tabulation. By comparing the steam consumption of the various arrangements, it is readily seen that for all load conditions the first case gives the best results and meets

Steam consumption curves


3,000-Kw. Bleeder Condensing Turbine - 400 Lb.-100°S-27½ Vac. Bleeding @ 165 Lb. Per Sq. In. Ga.
Max. bleed - 7,000 lb. per hr. leak
60,000 lb. per hr. bled
50,000 lb. per hr. bled
40,000 lb. per hr. bled
30,000 lb. per hr. bled
Straight condensing (Mech. engaged)
Steam Flow To Throttle, (1,000 Lb. Per Hr.)
Load in 100 Kw.
FIG. 1




1,500-Kw. Non-Condensing Initial 400 Lb. Ga.-100°S Back Pressure 165 Lb. Ga.
Steam Flow To Throttle (1,000 Lb. Per Hr.)
Load in 100 Kw.
FIG. 3

all load conditions economically. Although the total expenditure and cost per installed kilowatt is not the lowest, the flexibility and advantage of three units offset the additional cost. It will be noted that the cost per installed kilowatt in the fourth case is lower, but the total expenditure is the greatest. This demonstrates the fallacy of basing the selection primarily on cost per kilowatt for the total available capacity of 10,000 kw. This is in excess of the estimated future requirements of the system, and the high initial cost would give a correspondingly low return on the investment.

The two 3,500-kw. bleeder condensing units, shown in the second case, are lower in initial cost, but their higher steam consumption will more than offset the lower fixed charges. In addition, one turbine would not carry the base load of 4,800 kw., in case of failure of one unit for any considerable length of time. The piping and general plant investment with only two units and two condensers would be low, and a great deal of thought may be given to chancing the probability of a failure of one unit and installing the second arrangement with a resulting low initial cost. Sound engineering and good judgment, however, dictate that it would be far more economical to have sufficient standby.

Type	Estimated First Cost Dollars	Steam to Throttle. Day Load Conditions, lb. per hr.	Steam to Throttle. Night Load Conditions, lb. per hr.
1. 1—3,000-kw. bleeder condensing 1—3,000-kw. condensing 1—1,500-kw. back-pressure	$195,000	177,225 lb.	82,000 lb.
2. 2—3,500-kw. bleeder condensing.	170,000	178,000 lb.	82,500 lb.
3. 3—2,500-kw. bleeder condensing.	203,000	186,000 lb.	90,400 lb.
4. 2—5,000-kw. bleeder condensing.	228,000	180,000 lb.	83,000 lb.

	Cost per Kw. Installed	Cost per Generated Kw. Based on 6,000 Kw.
1.....	$26.00	$32.00
2.....	24.28	28.33
3.....	27.06	33.83
4.....	22.80	38.00

▼ ▼ ▼

High Cost of Caustic Embrittlement

CAUSTIC embrittlement has been discovered by "Hartford Steam Boiler" inspectors since Jan. 1, 1930, in steam-generating equipment with an estimated value of $4,000,000. Evidences of "embrittlement" have been found in 160 boilers and one kier in 58 plants scattered over 24 states. The cost of replacement or repairs is estimated at $750,000, the difference between this and $4,000,000 being because some boilers worth as much as $500,000 have been repaired and continued in service with a careful watch maintained.

In no case has "embrittlement" been discovered where there was a feedwater treatment record which indicated no departure at any time from the sodium carbonate to sodium sulphate alkalinity ratios at least as favorable as those recommended by the A. S. M. E. Boiler Code.

The feedwater in a number of plants affected was from deep wells and was untreated. In other plants base exchange type of water treatment was employed for the entire supply or for the make-up water. In still other plants soda ash and lime treatment was used, while at some the treatment consisted of secret commercial compounds. Changes in feedwater treatment and the absence of records in some plants make it difficult, if not impossible, to attribute the development of "embrittlement" to any one particular feedwater.

A.W.A. PLANT

By GUY M. HANNA
Chief Engineer, A.W.A. Clubhouse

IN APRIL, 1933, a 400-kw. vertical Unaflow steam-engine generator set was placed in operation in the American Women's Association Club House, New York, N. Y. This engine was operated on steam purchased from New York Steam Corp. and exhausted to the building heating system and water heaters for a laundry and swimming pool. In February of this year two oil-fired boilers were placed in service. Operating savings are indicated of approximately $40,000 a year over the average cost of steam and electricity during the previous three years.

The A. W. A. Club House is a 27-story building on 57th St., New York City, containing 1,250 guest rooms, large ball room, several restaurants, swimming pools and gymnasium. Mechanical equipment in the building consists chiefly of nine elevators, laundries, kitchen, 30-ton refrigerating plant and more than 160 motors of different sizes. The heating system contains 40,000 sq.ft. of direct radiation, 17,000 sq.ft. of indirect radiation.

At the time the building was opened in 1929, electricity and steam were purchased. But room was provided in the building basement for a boiler plant, although limited to a space 32x47 ft. by 13½ ft. high. A chimney was also provided, although its area was only 16 sq.ft.

The engine was installed as close as possible to the inside wall of the boiler room, and with its foundation, electrical switchboard and piping, cost approximately $73,000. It was purchased on a "pay out of savings" contract from Skinner Engine Co.

While operating on purchased steam, this engine was shut down every night, low-load electric energy being purchased from the utility. Enough kilowatt-hours were used at these times to make up the maximum allowed energy use on a 300-kw. breakdown service costing $600 a month. Steam, however, was not purchased at the most advantageous rate that would apply with the generating plant, because it would have necessitated a one-year renewal of the contract for steam, thus delaying the contemplated boiler installation. Had the power rate for steam been contracted for, the cost of operating the engine would have been considerably less.

Union Iron Works water-tube boilers were installed in the same room as the engine, there being no dividing wall between them. The two boilers each contain 3,280 sq.ft. of heating surface, and are designed for 200 lb. working pressure and 200 per cent rating. Each is fired from the low end by three Todd wide-range oil burners. To get sufficient combustion space, it was necessary to excavate 4 ft. below the basement floor, leaving a clearance of only 4 in. between the top of the drum and the horizontal building beam. Installed cost of boiler and combustion equipment of $37,000 is also being paid out of savings.

OPERATING SAVINGS ARE $47,000

An 8,000-gal. fuel-oil tank, together with two duplex fuel pumps and two fuel-oil heaters, was installed. Oil is delivered to each of the three burners by two oil lines, a maximum oil line and a minimum oil line. Oil to each burner is controlled by a master valve in each line; this master also controls the pressure, according to steam demand. In addition, oil is fed through a reducing valve from the main oil line to the burners at 100 lb. pressure, so that in case the master valve should close completely, oil would be supplied through the reducing valve, preventing the burners from going out. This makes a very flexible arrangement, and loads from 50 to 200 per cent rating can be controlled with a steam drop of only 3 lb. An automatic damper regulator controls the pressure in the furnace.

During the winter, normal steam demand varies between 12,000 and 15,000 lb. per hour. On zero days a peak of 20,000 lb. of steam has been reached. One boiler normally carries the load, but in extreme cold weather two are kept in operation, even though one boiler can handle the peak if necessary. The present rate of steam consumption is approximately 72,000,000 lb. a year, and the electricity about 1,700,000 kw.-hr. a year, which is higher than in previous years due to increased occupancy.

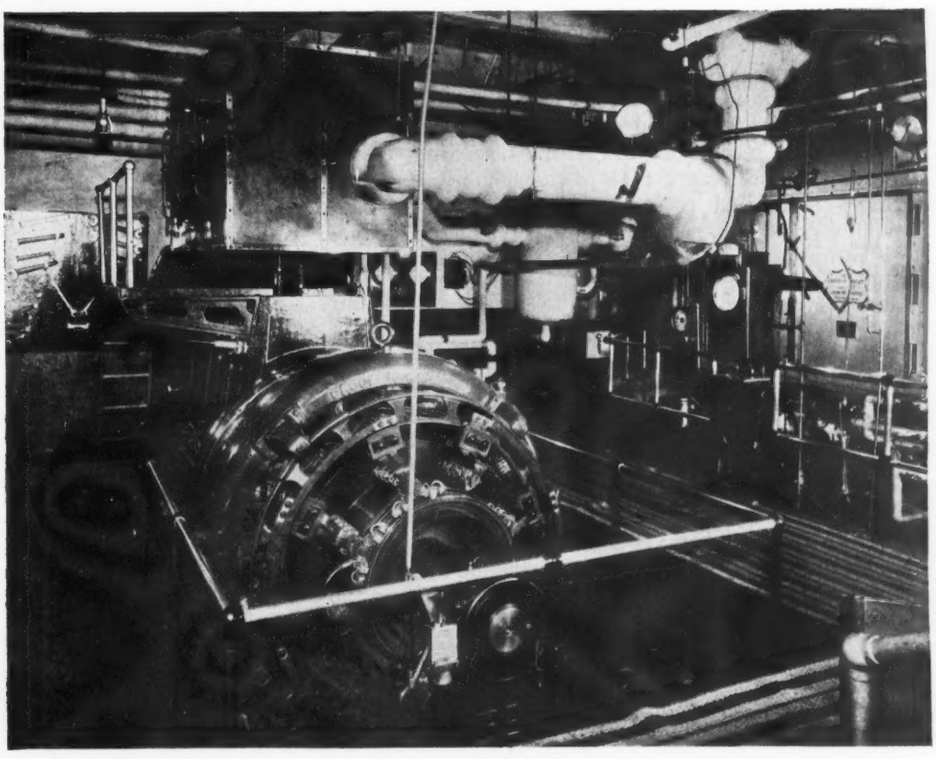
An actual evaporation of 14.5 lb. of steam per lb. of oil is regularly obtained. A recording CO_2 meter has been installed, and between 12½ and 13½ per cent CO_2 is maintained at all times. Furnace draft averages between 0.12 and 0.18, and flue gas temperature varies between 450 and 525 deg. Steam costs 25 cents per thousand pounds—which includes the cost of fuel, labor, supplies and maintenance. Because of the automatic control and the arrangement of the power plant, one man per shift operates the plant.

To show the savings made by this building power plant, monthly costs for steam and power are tabulated for the years 1930, 1931, 1932 and 1934 to date. The total consumption of electric energy and steam for each of these years is included for comparison. Up to and including March, 1933, these costs are the monthly bills for power and steam paid to local utilities.

The 1934 costs shown in the table are operating costs only and do not include interest and depreciation charges, for the reason that the entire plant is being paid for out of the savings; no cash outlay has been made by the purchaser. The boilers went into operation Feb. 5, 1934.

COST STEAM AND POWER 1930-1934

	1930	1931	1932	1934
JANUARY	$ 8,276.68	$ 8,292.68	$ 6,961.84	$ .....
FEBRUARY	7,246.85	7,503.42	6,929.49	2,823.70
MARCH	6,697.07	6,478.36	6,894.00	2,682.26
APRIL	8,543.90	9,057.85	9,717.75	2,592.62
MAY	6,228.28	6,601.37	6,539.17	2,597.98
JUNE	4,795.64	4,868.72	5,103.29	2,559.11
JULY	4,077.78	4,244.67	4,578.48	2,475.63
AUGUST	3,700.96	4,375.34	3,952.60	2,544.42
SEPTEMBER	3,686.04	4,461.49	4,707.45	2,412.76
OCTOBER	5,074.87	5,310.38	5,956.75	.....
NOVEMBER	6,620.50	6,264.83	7,009.20	.....
DECEMBER	7,550.42	7,020.91	8,165.10	.....
TOTAL	$72,498.99	$74,480.02	$76,515.12	.....
Kw-Hr. per Year	1,289,370	1,410,040	1,507,320	.....
Steam M lb. per Year	42,146	42,296	45,993	.....



Boilers and engine in the same room and combustion control help to keep operating force at a minimum

ROTARY PUMPS

THEIR OPERATION AND APPLICATIONS

By WILLIAM E. BAKEWELL
Research Engineer, Viking Pump Company

POWER pumps in common use may be divided into reciprocating, centrifugal and rotary types. While a vast literature has been built up around the reciprocating and centrifugal types, rotary designs have not been given the attention their importance in pumping applications warrants. In this article attention will be given to some of the more common designs of this pump, their characteristics and applications.

In spite of a superficial resemblance to centrifugal pumps rotary pumps are really more like reciprocating pumps because both have positive displacement. Some of the most widely used types are the external-internal gear, two external spur gears, two herringbone gears, vane types (usually guided or swinging-vane construction), the eccentric piston type and the lobe or cam type. These types, while their appearance varies greatly, have similar characteristics and all offer the same advantages.

Rotary pumps to a degree combine the *constant*-discharge characteristics of the centrifugal pump with *positive-discharge* characteristics of the reciprocating designs. Some of the most widely used rotary pumps are shown in Figs. 1 to 7.

Fig. 1 shows a gear-type pump. The gears rotate in the direction of the arrows and have very close clearances with the casing. Where the gear teeth contact they also form a fluid-tight joint. When the pump is primed, liquid flows in between the gear teeth, on the suction side, in very much the same way that it would flow into the cylinder of a reciprocating pump when the piston is on the suction stroke. As the gears rotate, the fluid is trapped between their teeth and the casing and is carried around to the discharge. Since the liquid cannot escape back to the suction a pressure is built up sufficient to force it out the discharge pipe. It will be noted that each gear tooth acts like the plunger in a reciprocating pump to force the liquid out of the discharge.

Lobed-Impeller Types

Figs. 2 and 3 show cross-sections through rotary pumps of the two- and three-lobed impeller types. These operate like the gear type, Fig. 1, except fluid is delivered to the discharge in a smaller number of larger quantities. Therefore, flow from pumps of this design is not quite as constant as from the gear type.

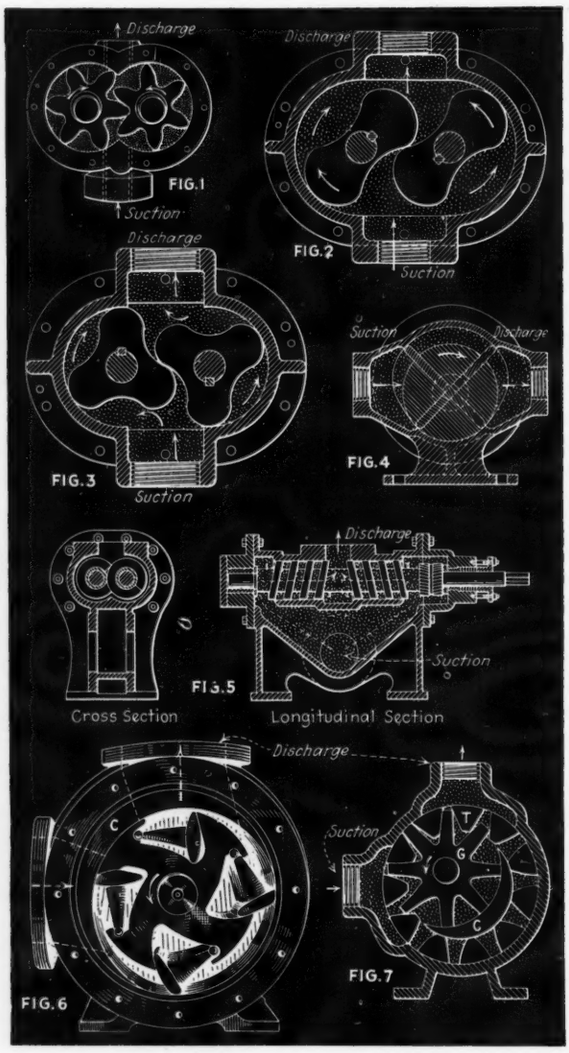
A cross-section of a sliding-vane type pump is shown in Fig. 4. The vanes are free to move radially in the rotor, which is set off center with the casing. As the rotor turns in a clockwise direction, fluid flows in between the upper side of rotor and the casing, is trapped by the vanes and is forced out the pump discharge. This action is similar to that of the designs in Figs. 1 to 3, except in Fig. 4 all work is done on one side of the rotor.

In the screw-type rotary pump, Fig. 5, two screws mesh to form a fluid-tight seal and the screws run with very little clearance in their casing. Fluid flows into the screws at the suction ends, is trapped between the threads and the casing, and is carried forward to the discharge as the screws turn, very much as a nut would move along the screws.

A swinging-vane type rotary pump is shown in Fig. 6. In this design the rotor consists of four arms that support swinging vanes. The rotor is smaller than the bore of the casing, but one side is closed with a cres-

TYPES OF ROTARY PUMPS

Fig. 1—Gear type. Figs. 2 and 3—Two- and three-lobed impeller types. Fig. 4—Sliding-vane type. Fig. 5—Screw type. Fig. 6—Swinging-vane type. Fig. 7—Internal-gear type.



cent *C*. This crescent is solid between the intake and discharge and, with the rotor arms, acts as a seal between the two. As the rotor turns, fluid flows from the intake into the space between the arms. Then, as the swinging vane passes the intake opening it is thrown out by centrifugal force and traps the fluid, which is carried around and forced out the discharge in much the same way as in the sliding-vane type, Fig. 4.

Internal-Gear Type

A somewhat different design from those described is the internal-gear type, Fig. 7. The rotor of this pump carries on its outer periphery what might be considered a gear, the teeth *T* of which are supported at one end on the rotor disk. This rotor revolves concentrically in the casing. Supported off center with the rotor is a free running gear *G* which meshes with and is driven by the rotor gear teeth. A crescent *C* supported from the end cover of the pump acts to insure a seal between the suction and discharge.

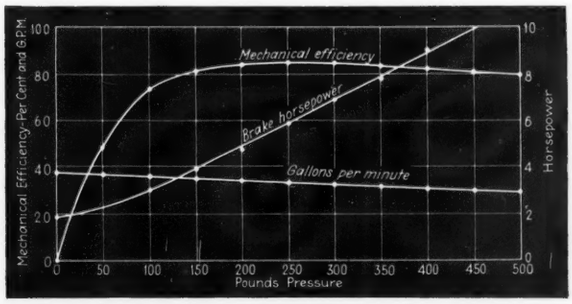


Fig. 8—Characteristic curves of a small rotary pump operating against different pressures

With the rotor turning in a counter-clockwise direction, as it turns by the intake, the teeth of gear *G* are withdrawn from between the rotor teeth. This action is similar to a piston on the suction stroke of a reciprocating pump and fluid flows in to fill the space between the teeth. As the rotor continues to turn, fluid is trapped between the teeth, crescent and casing and is carried around and forced out the discharge by the internal gear teeth meshing with those on the rotor. Other designs of rotary pumps have been developed and are in use, but those described will give a general idea of the principles involved.

Rotary Pump Advantages

Advantages of rotary over reciprocating pumps are that they deliver a continuous flow practically free from pulsations, they avoid reciprocating complications, are simpler in construction, they are much smaller in dimensions for a given capacity, occupy less space and cost less to install and maintain.

Rotary pumps can handle almost any liquid as long as it is free from grit and abrasive particles. It is difficult successfully to handle liquid containing abrasives with any type rotary pump because of excessive wear. This wear soon destroys the seal between rotating members and the casing, causing leakage losses, usually called slip, that reduce the volumetric efficiency below allowable limits.

Rotary pumps are particularly adapted to handling liquids of high viscosities, such as heavy fuel oils, tars, pitch, asphalt, heavy lubricating oils and governor pressure oils. With such liquids there is very little loss due to slip with an increase in the discharge head. Best results are obtained when the peripheral speed of the rotating members is comparatively low.

Rotary pumps are not limited to the handling of liquids of high viscosities, but have been used widely for pumping gas oil, gasoline, light-fuel oils, and benzine, etc. These liquids can be transferred at reasonably high pump speeds. Rotary pumps are also well adapted to handling fluids that might be affected by the severe agitation that occurs in a centrifugal pump or for applications where a constant volume must be delivered against a varying head. These pumps have advantages for such services as they are self-priming and capable of operating against a suction lift up to 25 ft. or more.

Most industries can use rotary pumps of some type either directly or indirectly. They are used in breweries, distilleries, wineries and food product plants of all descriptions. Rotary pumps with a take-down feature are well adapted to uses where frequent cleaning is necessary, as in creameries.

Rotary Pumps Under High Pressure

Until recently rotary pumps were considered applicable to low pressures only, up to 100 lb., but they are now available for high pressures.

For high-pressure work they must be especially designed and of suitable materials, heat-treated to stand the service. Bearings must be ample to carry the load. It is customary to use either ball or roller bearings. Unless pumping a liquid with good lubricating qualities, the bearings must be protected from contact with the liquid. It is best practice to mount the bearings outside the pump so that they make no contact with the liquid. This is essential when pumping water or corrosive liquids.

It is also necessary to control the thrust or undue loads imposed on the rotating members by the fluid being pumped. This is done successfully either by hydraulic or mechanical means, as in centrifugal pumps. Successful operation in high-pressure service depends on a properly designed unit. I believe that in the future pressures of 1,000 lb. or more will be successfully handled by rotary pumps.

Rotary pumps are being applied successfully to vacuum service. Here it is necessary to furnish a good grade of oil for the seal. Internal clearances should be reduced to the minimum. A separator on the discharge side is essential, and a method to drain off the condensation should be provided in the oil trap if possible.

The efficiency of rotary pumps is in general comparable with that of other types. The efficiency curve, Fig. 8, is for a small pump operating under various pressures. At 250 to 300 lb. pressure the efficiency is at a maximum of about 85 per cent. Beyond 300 lb. pressure the efficiency falls off, due to increased slip in the pump, increased friction and other factors.

The rotary pump, being of the positive discharge type, cannot be operated against a closed discharge. Where such operation is required an automatic unloader must be provided to bypass the discharge into the suction well. If the discharge valve were closed with the pump in operation, without an unloader, the pressure would build up in the pump until its casing would fail, the driving motor trip its overload device or stall.

TAILOR-MADE WEATHER

By R. B. PURDY
Associate Editor

Air conditioning is just a new setup of some old and familiar power units. Behind the false front of fancy words, the same old pumps, fans, heating and refrigerating coils are doing the same old job

"IT AIN'T the heat; it's the humidity." This good old American saw is looking a little the worse for wear these days, for now even the corner movie and the office buildings uptown proclaim that they make their own weather. Just what is this tailor-made weather, this "air conditioning," as they call it?

Behind the new words—humidifiers, dehumidifiers, filtered air, dewpoint, vitiated air—and the rest of the beard and dark glasses that have helped air conditioning look so mysterious and inviting, there is just a new arrangement of the same old pumps, fans, heating and refrigerating coils, spray washers and so on that power engineers have been dealing with for years. In a nutshell, air conditioning is simply a combination of power services to provide, at any season, and in spite of any outside weather variations, inside air that is comfortable.

This means that the air will have to be cooled in summer and have some of its moisture (our old friend the humidity) taken out, in winter it will have to be heated and have some moisture added to make up for the usual dryness of outside winter air. Since the air has to be pumped anyway, we may as well take out the dust and dirt—and the odors—at the same time. All that remains is to get the air into the rooms and out of them again without creating drafts and to limit the amount of air that must be handled by keeping doors and windows closed.

It is my purpose here to explain away some of the worries of power engineers who are facing installation of air-conditioning. Any man fears the new and strange, and *Power* has been as guilty as anyone else of using the lingo of this new profession, without stopping to explain that these elaborate terms and ideas are just window dressing for a combination of old and familiar ideas. After all, when you've once learned to handle power equipment, a new arrangement can only cause temporary trouble; when you've learned to play the piano, you can play any tune.

We Always Did It

We've been heating air for years, we've been cooling it, perhaps even taking out or adding moisture. (Your mother and mine had a pan of water on the stove in winter—a simple "humidifier.") We've been using "unit heaters" as well as central heating plants. Air conditioning systems may be classified the same way—by calling them *unit systems,* in which the equipment is right in the space to be conditioned, or *central systems,* in which the equipment is in some central place and air at the required conditions is delivered by fans through ducts to the space to be conditioned. In either case, the air delivered must generally be lower in temperature and humidity in summer, higher in temperature and humidity in winter, than the temperature and humidity desired. Only thus will it have capacity to absorb (summer) or transmit (winter) heat and moisture from or to the greater mass of air in the space to be conditioned and thus give the desired result.

I said to begin with that air conditioning was simply a new combination of several old functions with which any engineer is familiar. Probably the easiest way to prove it is talk about each function individually.

Cooling

Cooling was the first step toward air conditioning, made when movies found that the sweating citizenry would pay to come in out of sweltering summer days in response to the magic sign: "20 Degrees Cooler Inside." But cooling alone is refrigeration, not conditioning. Unless some of the moisture in hot summer air is taken out, it must be cooled excessively, thus causing chills and colds instead of comfort.

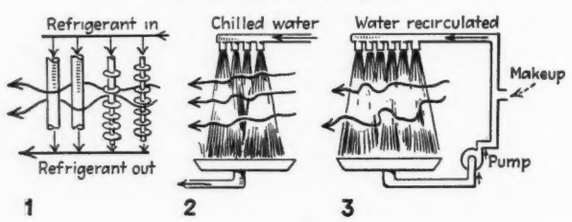
There are three common ways now used to cool air:

1. Circulating the air over plain or finned coils through which either a refrigerant or chilled fluid is pumped.

2. Passing the air through a spray of chilled water.

3. Passing the air through a spray of recirculated water and depending upon evaporation for cooling. The degree of cooling possible with this method is lim-

Three methods of cooling air



ited because it depends upon the outside wet bulb temperature. As you know, wet-bulb temperature is usually appreciably lower than dry-bulb temperature, just as your finger feels cooler if you wet it. As the air to be cooled passes through the spray, a certain amount of the water is evaporated, the amount depending upon the difference between wet-bulb and dry-bulb temperatures. Heat is required for this evaporation, and the necessary heat is taken from the air, thus cooling it.

Dehumidifying

Dehumidifying, of course, is simply removal of moisture from the air, and is accomplished in either of two ways:

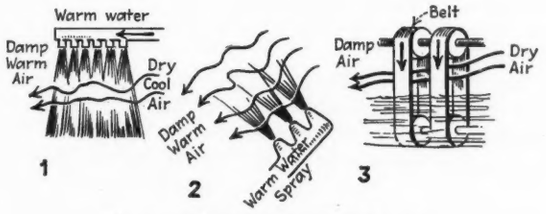
1. Cooling the air to the desired dewpoint, thus forcing the "extraneous" or extra moisture to condense out. At any given temperature and pressure, air can only carry a given amount of moisture, the amount being smaller as temperature drops. Therefore, if the air contains too much moisture, it is cooled until the extra moisture is condensed out, then reheated if necessary and readmitted to the room. As it reaches room temperature, its capacity for absorbing moisture is increased and it takes some moisture from the other air in the room, thus reducing the amount of moisture per unit of air.

2. Passing the air over chemical substances that have a great affinity for water, such as silica gel and calcium chloride. Such chemicals, which literally "sponge" the invisible moisture from the air, must be squeezed out or "regenerated" regularly by heating them to drive off the moisture they have absorbed. This method has been used successfully for industrial air conditioning where very low dewpoints (very low moisture content in the air) are desired without air cooling.

Humidifying

There are two general methods for adding moisture to the air:

1. Large air-conditioning systems pass the air through a water spray that has been warmed to the desired dewpoint temperature (the temperature at which the air will just hold the desired amount of moisture).



Three methods of humidifying air

The air leaves such sprays saturated with moisture and at the temperature of the water. Means for eliminating entrained moisture (visible fog or spray) must be provided.

2. Injecting a highly atomized water spray into the air. Other systems use steam jets, evaporation from water containers, evaporation from wicks or soaking belts.

Heating

In central air-conditioning systems there are three reasons for heating the air. During freezing weather, make-up fresh air must be heated before it passes to the air washer; otherwise the water in the washer may be frozen. Steam-heated finned tubes or cast-iron "vento-radiation" are used for this purpose. During cool, humid weather, air cooled in the dehumidifier to reduce humidity must be reheated to prevent room temperature from being too low. This is often accomplished by mixing warm return air with the cool air coming from the dehumidifier. During colder weather some steam-heated radiation must be added to attain the desired temperature. Sometimes return air cannot be circulated because of the odors it contains. In that case reheating must be done with steam or hot-water radiation.

Refrigeration

Several methods of refrigeration can be used in air conditioning. They include:

1. Mechanical refrigeration, using any of a number of refrigerants, such as ammonia, Freon, carbon dioxide, Carrene, sulphur dioxide, etc.

2. Water vacuum refrigeration, using either steam jets or a centrifugal compressor.

3. Cold well water, when available, or ice.

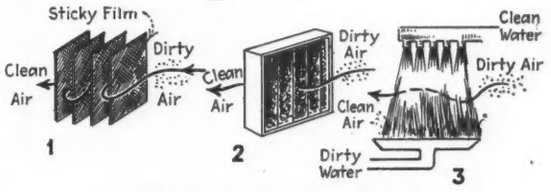
Usually the refrigerating plant cools the water or some other circulating medium which then is passed through the air cooling coils. In some cases the refrigerant itself is passed through the cooling coils, particularly when it is cold well water.

Refrigeration for air conditioning requires temperatures of only 45 or 50 deg. and some means of controlling capacity to meet the wide variations in load. These requirements should be carefully considered when a refrigerating system is selected.

Filtering

Three types of filters are commonly used in air-conditioning work. They are:

1. Viscous film filters, either the cellular type arranged for easy removal and cleaning, or the automatic



Three ways to filter dirt from air

cleaning type. Impurities such as dust and dirt in the air are caught in the film as the air passes through.

2. Dry-type filters, usually a simple baffle arrangement of coarse material which catches and holds the heavier dirt particles as the air passes through. Mineral wool and glass wool are typical ones.

3. Air washers, utilizing water sprays to wash out the dust and dirt. When air washers are used, it is customary also to install one of the other types of filters to clean the make-up air and return air that is bypassed around the air washer.

When the air is heavily loaded with industrial dusts or other impurities, other types of dust removers must be used, such as cyclone separators, impingement dust collectors, electric precipitators, bag filters and vertical dust collectors.

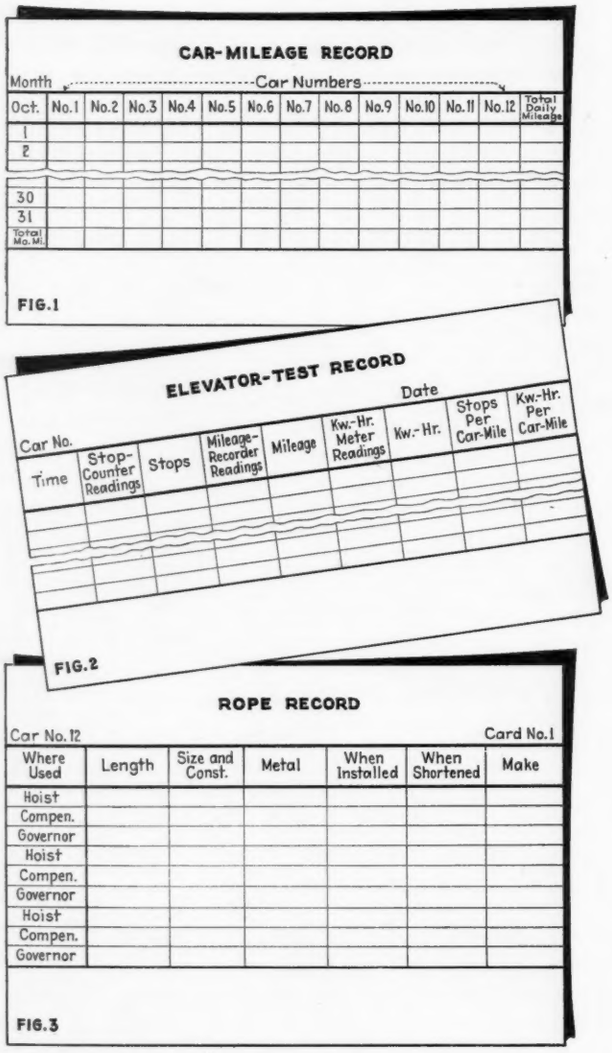
Removal of Odors

Removal of odors is a more difficult problem. Certain dry-type filters are claimed to be able to remove

(Continued on page 607)

BETTER MAINTENANCE KEEPS

By CONRAD LANGSCHULTZ
Chief Engineer, 63 Wall St. Bldg.



CAR-MILEAGE RECORD

Month ..... Car Numbers .....

Oct.	No.1	No.2	No.3	No.4	No.5	No.6	No.7	No.8	No.9	No.10	No.11	No.12	Total Daily Mileage
1													
2													
30													
31													
Total Mo. Mi.													

FIG. 1

ELEVATOR-TEST RECORD

Car No. Date

Time	Stop-Counter Readings	Stops	Mileage-Recorder Readings	Mileage	Kw.-Hr. Meter Readings	Kw.-Hr.	Stops Per Car-Mile	Kw.-Hr. Per Car-Mile

FIG. 2

ROPE RECORD

Car No. 12 Card No. 1

Where Used	Length	Size and Const.	Metal	When Installed	When Shortened	Make
Hoist						
Compen.						
Governor						
Hoist						
Compen.						
Governor						
Hoist						
Compen.						
Governor						

FIG. 3

Forms for recording elevator performance

IN THE Wall & Hanover Realty Corporation building at 63 Wall Street, New York City, eternal vigilance and cleanliness have an important place in elevator maintenance as it should have in every maintenance program. In this building are sixteen elevators, twelve for public and four for private service. The public cars are arranged in three banks of four each. One bank operates locally from the 1st to 13th floor; another runs express to the 13th and local to the 22nd; the third bank runs express to the 22nd and local to the 35th floor.

All cars operate at 700 ft. per min., and (with the exception of the service car, which has 3,500-lb. capacity) are designed for 2,500-lb. load. Each elevator machine has a mileage recorder. The chief purpose of the recorders is to give a record of cable life, but they also are used for periodic performance checks.

The elevators are not equipped with watt-hour meters, but the operating crew has three of these meters that may be connected to test any machine. Four stop counters are also available for test purposes. In addition, a recording wattmeter, tachometer, indicating voltmeter and ammeters are part of the metering equipment so that any necessary investigation of elevator performance and power supply can be made.

There is also a watt-hour meter on the power supply including elevator load and a watt-hour meter on the lighting load. Normally these meters and mileage recorders on the elevators are read daily and these readings recorded in a book. Two facing pages of this book are ruled to record all the important daily meter readings in the building for one month. One page shows power, steam and other quantities. On the other is the daily record of mileage-recorder readings, Fig. 1. On the right-hand side of the page is a column for daily total mileage for 12 cars. At the bottom of the record sheet is a line in which total monthly mileage is entered. In space below the mileage record, major items of information regarding elevator operation are recorded.

Test When Doubtful

Whenever there is any doubt about the performance of an elevator a daily or a monthly test is made. Generally the test is made on two cars in the same bank doing similar service. A watt-hour meter and a stop counter are connected to each machine under test. For the first day of the test, watt-hour-meter, mileage-recorder and stop-counter readings are taken hourly and recorded. After that the readings are generally taken daily and recorded on a form, Fig. 2. From these records a check can be made of total stops, stops per car-mile, kilowatt-hours per car-mile, etc. The good condition in which the equipment is kept is indicated by the low power consumption, which on the high-rise cars is down around 3.5 kw.-hr. per car-mile, going as low as 3.39.

The ropes have outstanding importance in every elevator installation, both for safety and for economy of operation. All ropes are inspected each month. During these inspections lack of lubrication, broken and worn wires and conditions that might be injurious to the ropes are discovered. Once per week the tops of the cars are inspected and cleaned and the position of equalizer bars is checked for unequal stretch or loading of hoist ropes. Guiderail lubricators, guiderail lubrication, guide shoes and door operators are inspected.

Once each week elevator pits are cleaned and a check made of the tension in compensating ropes and position of the compensating and governor sheaves. During this inspection, guide shoes, safety equipment and traveling-cable connections on the bottom of the car are given attention.

The elevators went into operation in April, 1929. In 1931 automatic equalizers were installed on the hoist ropes of the twelve public cars. At that time the hoist ropes on No. 12, which is the high-rise service car and operates 24 hr. per day, were renewed as they

ELEVATORS ON THE JOB

Twelve passenger elevators are maintained so that their total outage time, during periods of need, is less than 0.1 of one per cent

were getting in bad condition. These ropes, which were of a 6x19 construction, had gone 20,360 mi. The renewed ropes, which are 8x19 construction, were replaced recently after a service of 62,400 mi.

Rope life is rather an uncertain quantity. It is not, however, unreasonable to assume that the high-service mileage obtained from the second set of ropes is in no small part due to their being more flexible than the first set and to the automatic equalizer. The latter not only automatically compensates for unequal loading and stretch in the ropes but indicates when corrections should be made to take care of excessive unequal stretch.

The ropes on the other three high-rise cars had equalizers put on them when they had gone about 8,000 mi. These ropes are still in service. One set has a mileage record of 33,000 and the other two sets 30,000 mi. Oct. 1. Two sets of these ropes, which are 8x19 construction, are in good condition and from all indications will give a long period of additional service. The third set of ropes, 6x19 construction, is beginning to show signs of deterioration, such as broken wires, but will probably be good for several thousand miles more. If performance of these ropes is to be judged from the first set on No. 12 car, with a service life of only 20,360 mi., then automatic equalizing of the load very materially extended their life.

Automatic Equalizers

Automatic equalizers on the hoist and compensating ropes will within reasonable limits maintain practically equal loading and will also show unequal stretch. Tests made on the hoisting ropes with a tensometer have shown practically equal loading even when the car is run the full length of the hoistway.

It should be emphasized that elevator-rope equalizers, like every other piece of equipment, should not be forgotten after being installed. They will take care of unequal stretch in ropes and maintain practically equal loading between them. To do this, however, they must be given a reasonable amount of attention to see that unequal stretch of the ropes has not gone to the equalizer limit.

A record of rope performance is maintained on a card system. On one card, ruled as in Fig. 3, a record is made of the service, whether hoist, compensating, or governor; length of ropes, size, construction and material of which they are made, date installed, date when shortened, and the make. On other cards are recorded the history of the ropes during their life. All the cards for a given car are filed in a division of an index box under the car number, so that at any time rope performance and factors that may have had an effect on rope life can be checked by referring to the card record.

The control, motor-generator sets and elevator machine are cleaned and inspected once a week, and the back of one control board each week is inspected and a check made for loose connections. By this means the backs of all control boards are checked every twelve weeks.

As a point of interest it might be mentioned that the cars are being equipped with fireproof traveling cables. This practice is the result of a rather serious fire in a hoistway caused by a broken wire in a traveling cable.

A record is also kept of total time cars are out of service when they are needed. In this building all cars are required from 8:30 a.m. to 5:30 p.m. to meet service demands adequately. Therefore it is essential that they be maintained to render as nearly as possible 100 per cent service. By improved maintenance methods it has been possible to cut the total outage time per year from 160 hr. for the twelve cars to 32 hr. Based on the hours that the cars actually should be in service, they are now available over 99.9 per cent of the time when needed. The other 0.1 per cent of the time some one bank of elevators is operating on a slightly reduced schedule.

Careful maintenance of the elevators and keeping a record of operation have reduced operating costs and, as previously mentioned, have improved service. The chief items of expense are for power, labor and ropes. Complete cost records are kept, and the average cost per elevator per year for material including ropes and lubrication is $100. This cost varies from about $70 per elevator per year for the low-rise cars to about $130 for the high-rise cars.

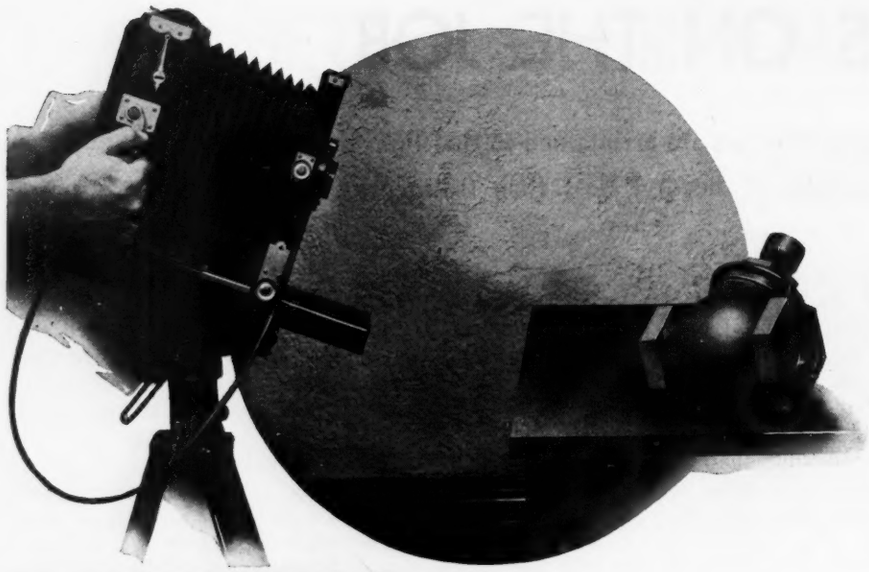
TAILOR-MADE WEATHER

(Continued from page 605)

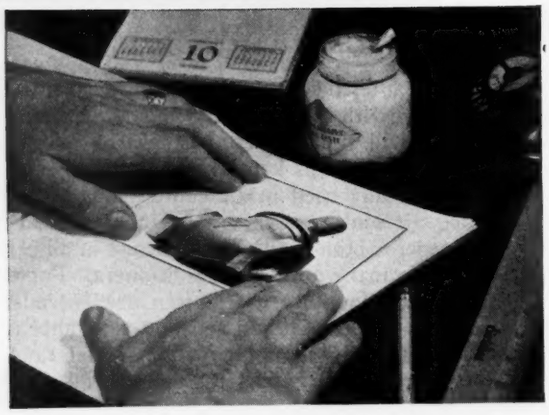
odors, but the filter material must be replaced promptly when saturated with the odor-producing substance. Air washers also will remove certain types of odors provided the spray water is kept fresh.

Fans are usually used in air conditioning to supply conditioned air and remove vitiated air. Radial-type fans are used for both supply and exhaust in all central systems, and in many unit-type conditioners. Forward-type multi-blade fans are most often used because of their low peripheral speed and constant-resistance characteristics of the distribution system. Axial fans are used in unit coolers in which the static head required is very low and the velocity high.

Air from a central conditioning system is discharged to the space to be conditioned through a grille or diffuser designed to distribute the air evenly and to mix it with the room air in such a way as to prevent uncomfortable drafts. Many special diffusers are available to meet the varying requirements of air conditioning, classified roughly as directing-vane type deflectors and nozzles. Where window outlets are used, nozzles are employed to direct the air vertically, making use of the ejector effect to cause the cool air to mix thoroughly with warm air.



By JOHN COLLISTER
Ohio Public Service Co.



"Shoot" picture—file negative by number—mount print in album. Photographic records of construction, break-downs, and repairs will save future dollars and arguments.

•

FILE PHOTO FACTS

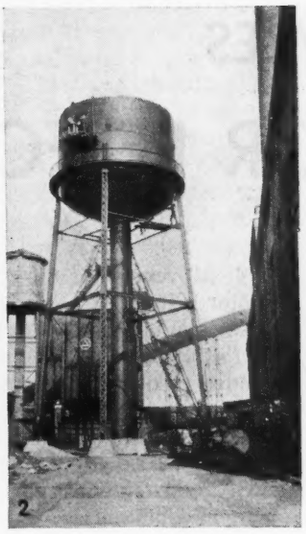
MAHONINGSIDE STATION, Warren, Ohio, operated by Ohio Public Service Co., a subsidiary of Cities Service Company, has found very valuable its system of keeping complete photographic records of construction, maintenance, and other work of unusual interest. These photographs are taken with a post-card-size camera kept at the plant.

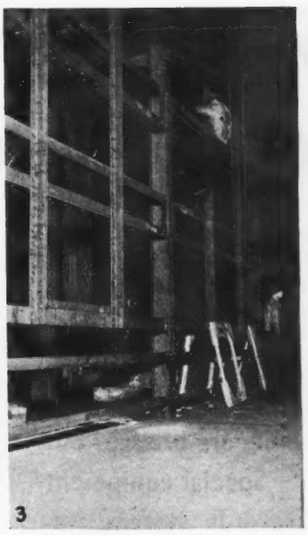
One print of each photograph is filed numerically in a 10x12-in. loose-leaf album. A number, assigned in the order in which the picture is taken, is printed with India ink on the print and its corresponding negative. A brief description is written under each picture as it is mounted in the album. Negatives are filed numerically in a cabinet-file drawer.

Each month a group of pictures is taken pertaining to activities of interest. These are used to illustrate the reports of superintendent and foremen, which are forwarded to the other offices of the organization.

These photographs have been found invaluable for the purpose of showing clearly and exactly any item of unusual interest important enough to be called to the attention of out-of-town executives. Duplicate prints in the albums give a complete and exact pictorial history of those activities. Selected photographs may easily be reproduced when occasion demands. Very often pictures taken for one purpose later become important for entirely different and unexpected purposes.

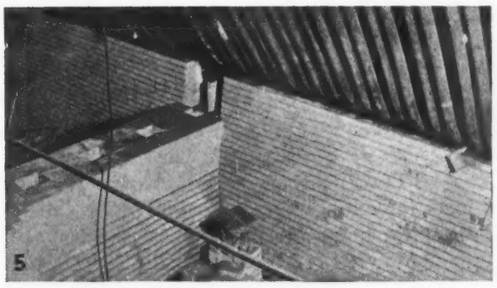
Photographs are used also to show progress of construction work: Photos 1 and 2 show the erection of a steel head tank. Photos 3, 4 and 5 record progress on

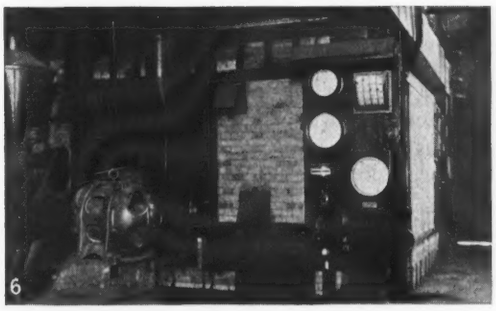




the work of rebuilding the settings of a battery of boilers. Certain details of construction of unusual interest are shown in this group. Photographs of the side wall and of the center wall show the hollow air-cooled construction which is saving $12,000 per year in reduced maintenance and improved boiler efficiency. With advancing fuel prices and the rebuilding of another battery of boilers, these savings will be increased.

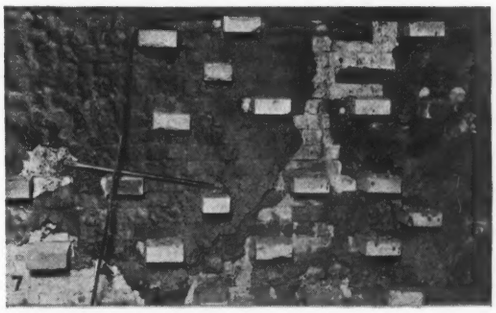
Fig. 6 shows the front of one of the boilers after rebuilding. The pulverized-coal burner shown was invented by C. H. Byers, superintendent of Mahoningside station, together with Wm. H. Byrne, who at that time represented Combustion Engineering Co. Letters patent for this burner have recently been issued to the inventors. The burner consists of a volute casing through which coal from the unit pulverizer passes with a whirling motion. Air is drawn through the circular opening in the corner, and mixes intimately with the fuel. This type of burner has been used for several years at this plant with marked success.





"One picture is worth ten thousand words"
—Confucius, 551-478 B.C.

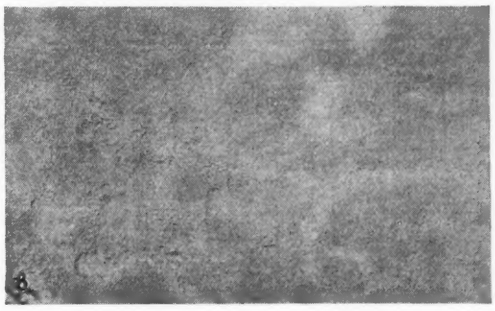
Photos 7 and 8 show how the furnace walls were successfully repaired. Projecting bricks were set endwise in the wall. The wall was then built up with a mixture of fireclay and binder shot on with a cement gun and firmly tied to the old wall by means of the brick "headers."



Photographic records such as these are used to present facts as evidence to justify new expenditures for construction. Existing conditions are shown clearly in photographs that enable executives in distant offices to see *why* they should be changed. When approval for new construction is asked, these pictures accompany the formal requisition and present convincing arguments.

When an improvement is made, a photograph of the new condition shows clearly, by contrast with the old, the betterment obtained.

This system of photographic records has been so valuable at this plant that the small expense required to operate and maintain it is negligible by comparison.



OSCILLOGRAPH ANALYZES GOVERNOR PERFORMANCE

By J. E. ALLEN
Pennsylvania Water & Power Co.

Important possibilities in the study of speed control of large power units are brought out by work at Safe Harbor. Special equipment with an oscillograph records system frequency and gate movement simultaneously, thus permitting analysis of governor performance. A later article discusses results

SENSITIVITY and speed change under sudden load rejection were important tests called for in the governor-contract specifications for Safe Harbor plant of Safe Harbor Water Power Corp. It was primarily to check governor sensitivity that need arose for accurate measurement of generator frequency or speeds. Since measuring equipment of the desired sensitivity and speed of response was not then commercially available, we were forced to develop suitable experimental apparatus. The solution was a combination of frequency bridge, amplifier and vacuum-tube wattmeter, using the oscillograph for recording. The following data were recorded by the oscillograph in studying the behavior of the Safe Harbor governors:

1. Turbine speed.
2. System frequency.
3. Movement of turbine-gate servo-motor piston.
4. Movement of the relay valve actuating the servo-motor piston.
5. Timing impulses.

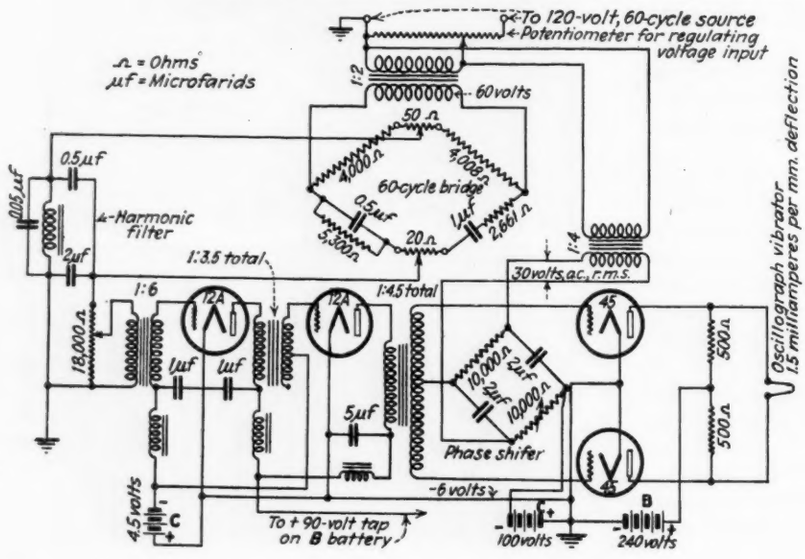
Turbine Speed: The projected program of governor studies required measurement of a wide range of speeds varying from approximately 25 per cent above normal for sudden load-rejection tests, to a few hundredths of a cycle (60 cycles) for determining sensitivity and studying governor operation under normal system conditions. For the former, speed was recorded on the oscillograph, using a small direct-current generator with its field excited from a storage battery and geared to the turbine shaft.

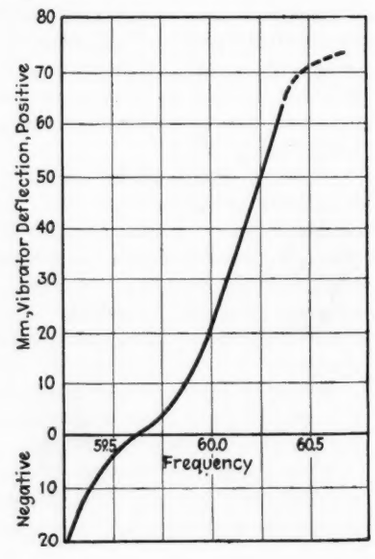
Sufficient sensitivity was obtained with a 4- to 5-in. deflection of the vibrator, this being the maximum obtainable with direct current due to thermal limitations. Since the more important tests were for overspeeds, between 10 and 25 per cent, a sensitivity of approximately 1 per cent speed change per millimeter deflection was considered adequate. Commutator ripple from this generator was minimized by using an inductance, caution being taken to avoid appreciable time lag.

Frequency Measurement: The second range of speed variation, covering a band of several tenths of a cycle, and readable to several hundredths of a cycle, was recorded on the oscillograph film by means of a frequency bridge, vacuum-tube amplifier, and vacuum-tube wattmeter, Fig. 1. The bridge chosen for this purpose was a so-called Wein type, using resistors and condensers.

Bridge output was first put through a filter to eliminate harmonics, amplified with a conventional two-stage, transformer-coupled, vacuum-tube amplifier, and finally fed into a vacuum-tube wattmeter consisting of

Fig. 1 (Left)—Connections for using a vacuum-tube wattmeter for recording changes in frequency with an oscillograph. Fig. 2—Typical calibration curve for the equipment, Fig. 1





two tubes in push-pull. A reference potential for the wattmeter was secured from the same source which energized the frequency bridge. This was taken through an insulating transformer and a phase shifter to correct for phase-angle shift in the amplifier. Sensitivity was controlled mainly by means of a potentiometer which regulated input to the amplifier. The vibrator used had a sensitivity of approximately 0.0015 amp. per mm. Normal values of constants used are shown on the figure.

The wattmeter effect serves two purposes: (1) It gives a rectified wave for the output. (2) It permits from the polarity indication a means of determining the direction of frequency variation with respect to an arbitrary zero corresponding to the value for which the bridge is tuned. The latter is particularly necessary in case the bridge is tuned close to the value at which measurements are made.

For most tests, however, the bridge was tuned substantially below the normal range of measurements encountered, to avoid the use of a calibration close to the point of polarity reversal. The calibration within the latter range may be non-linear, whereas for a range substantially above and below zero, calibration is practically linear, Fig. 2, and more desirable for the purpose intended.

The use of vacuum tubes as a wattmeter is not new, having been described in the *Proceedings* of the Institute of Radio Engineers, OCTOBER, 1930, *page* 1743. Calibration is done by impressing a voltage of known frequency on the bridge and observing on the ground glass the amplitude of vibrator deflection with respect to zero. The envelope of the individual waves constitutes the desired frequency record, the type of record obtained and the wave shape of the individual cycles being shown in Fig. 3. The wave shape is such that a substantial period of time elapses between cycles, thus giving the effect of a continuous zero line when slow film speed is used. Fig. 4 shows a slower speed film on which reversal of polarity occurs with respect to the frequency at which the bridge is tuned. Fig. 5 shows the type of record obtained when a slow film speed is used. At the top is the timing record, next the system frequency and at the bottom the record of gate servomotor piston movement for two turbines.

Different Sensitivities

Several calibrations providing different sensitivities were obtained by varying either the potentiometer control to the amplifier or the value of voltage impressed on the bridge. The most sensitive range secured provided a deflection of approximately 10 mm. per 0.1 cycle change over the linear portion of the curve covering a band of about 0.5 cycles. Tubes originally used were the 171-A type, but these were later abandoned for the 245 type. However, a more sensitive vibrator is now available (0.00015 amp. per mm.), permitting the use of the smaller size tube.

Calibration was made against a tuning fork as a standard, using a house generator from the system as a variable source of frequency. Deviations from the tuning fork frequencies were read from a special cone-shaped drum driven by a synchronous motor. The tuning fork and synchronous-motor driven cone comprised a commercial speed-measuring device made in England, called a Strobometer. A commercial indicating frequency meter having an open scale might also

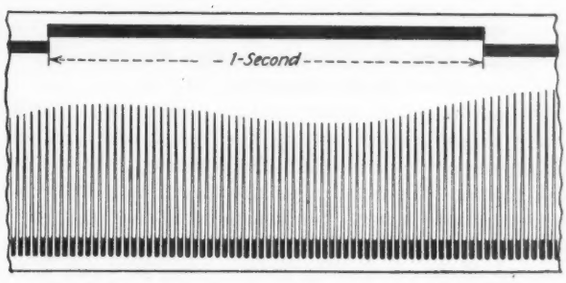


Fig. 3—Frequency record obtained with equipment, Fig. 1, using high film speed

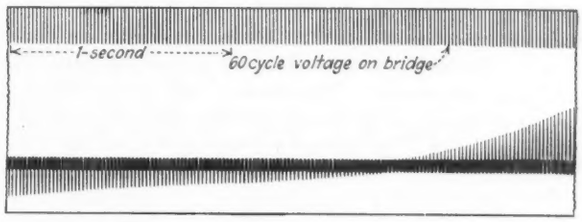


Fig. 4—Frequency record as in Fig. 3, but made on a slower-speed film and including a reversal of polarity

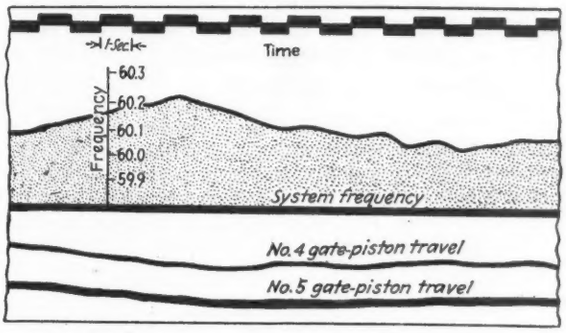


Fig. 5—Frequency record made with a slow film speed

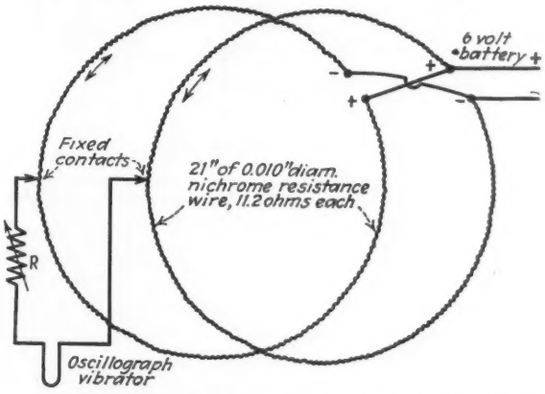


Fig. 6—Diagram of circular-type slide-wire bridge used to record servo-motor piston movement

be used. The absolute value of frequencies is not considered of great importance in the calibration, rather determination of the slope is the main objective when making a calibration. The main requirement of the standard is to remain constant.

Piston Movement: Movements of the servo-motor piston, which operates the turbine gates, were recorded on the oscillograph by means of a slide-wire arrangement. It was desired to record the slightest movement of the operating piston, consequently a conventional slide-wire resistance did not provide sufficient sensi-

tivity when using the standard vibrator. Accordingly, a circular type of slide-wire bridge was devised, with the arms differentially connected, Fig. 6.

In addition, operating-piston motion was mechanically amplified by putting the resistance wire on a larger-diameter drum than the actuating motions from the piston. Connection to this drum was made by a wire wrapped several times around it and secured to a counterweight. Each arm of the bridge consisted of a single turn of resistance wire stretched taut with a coil spring.

It is possible with this arrangement, using 6-volt direct current on the bridge, to obtain with the standard vibrator (sensitivity 0.005 amp. per mm.) a deflection on the film approximately 50 per cent greater than actual piston travel. This means that a movement of the operating piston could be observed on a film as small as $\frac{1}{32}$ in. This device served for measuring piston movement only, corresponding to normal operation. With large sudden load changes, an ordinary single slide-wire resistance gave sufficient deflection on a standard vibrator for the wide range of gate movement encountered.

Relay-Valve Movement: To analyze the type of impulse transmitted to the piston-operating cylinder, a sensitive electric gage was connected to the relay valve which showed valve movements of a few thousandths of an inch. This device, which was home-made, was similar in principle to one described in the A.S.T.M. *Technical Papers,* Vol. 30, 1930, p. 104. A gage similar in principle but of somewhat improved design, is described in *Electric Journal* for AUGUST, 1932, p. 380.

The gage operates on the variation in reluctance of two magnetic circuits as the armature is moved in an

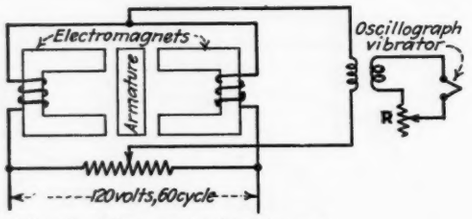


Fig. 7—Diagram of electric gage

air-gap. The change in the two magnetic circuits produced an unbalance in the bridge arrangement, an oscillograph vibrator being used to measure this unbalance as shown in Fig. 7. The armature is rigidly connected to the relay valve, and the magnetic circuit held stationary by a fixed mounting. Total amplitude of the vibrator deflection varies with the electric gage armature movement in the air gap, in accordance with a calibration curve. Fig. 8 shows the oscillograph record of piston travel, system frequency and relay valve action.

Timing Impulses: Timing impulses for the film were obtained by means of a General Electric timer, giving impulses of one second duration, with an omission of the 59th to facilitate counting them and providing 1-min. periods readily apparent on the record. This timing record is shown at the top of Figs. 5 and 8.

The modern multiple-element oscillograph proved highly satisfactory in providing means of simultaneously recording gate movement, and relay valve movement in addition to changes in frequency. The equipment fulfilled the requirements for sensitivity and at the same time provided a means of analyzing governor performance. The records also provided what is believed to be a still more important contribution—a knowledge of instantaneous-frequency behavior on a large power station. This has provided a better understanding of the fly-ball-type governor functions when regulating frequency on large systems.

When governors of great sensitivity are used their adjustment in operation becomes a problem to prevent the small periodic fluctuations or ripples from interfering with their intelligent response to small and much slower speed changes continuously occurring. Frequency ripples may originate either from load changes or certain types of reciprocating prime movers. At times the normal frequency variations are free from ripples, while at other times ripples are very prominent, depending upon the load and generating conditions. It is of particular interest that the fly-balls respond to these small fluctuations, demonstrating that the ripples in reality cause a speed change in the large generators in order to be transmitted to the motor-driven fly-balls from pilot exciter mounted on main-generator shaft.

Development work on the frequency bridge was initiated in March, 1932. At that time there was no commercial equipment available which would meet our needs. Since then commercial frequency recorders have become available, which would meet the requirements of sensitivity and speed of response needed in our studies. One such instrument, of the photo-electric type, manufactured by the General Electric Co., was compared, simultaneously, with an oscillograph record. The agreement between the two records is quite satisfactory, both in respect to sensitivity and speed of response, Fig. 9. If an additional pen were mounted to record simultaneous gate movements, it is felt that such a commercial instrument would give a satisfactory record for plotting Léauté figures. These figures are obtained by plotting servo-motor piston travel in inches against changes in frequency and will be discussed in the next article.

Fig. 8—Oscillogram record of time, piston movement, system frequency and relay valve action

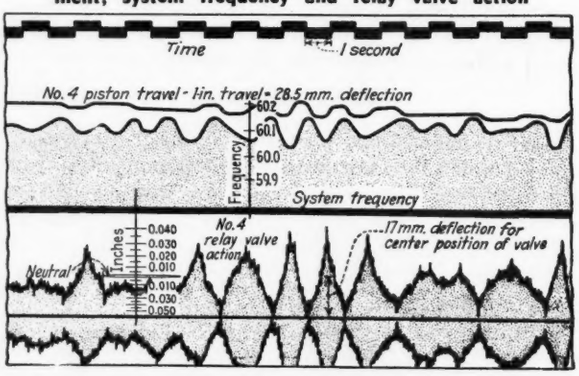
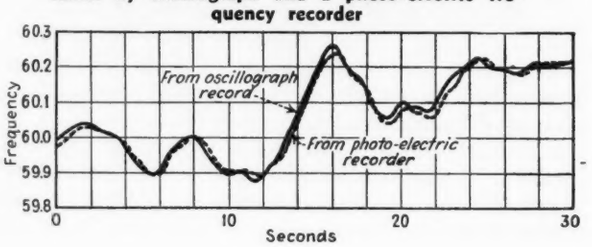
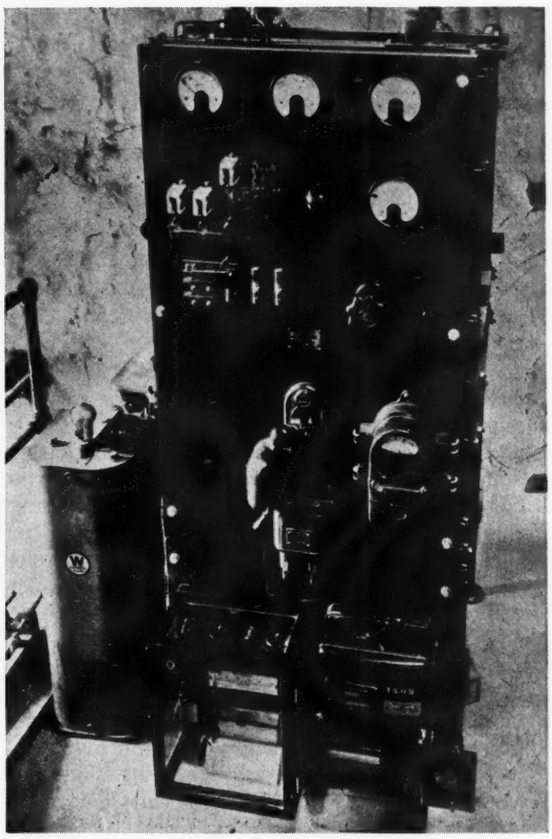


Fig. 9—Comparison of system frequency records taken by oscillograph and a photo-electric frequency recorder



GRAPHIC WATTMETER CONTROLS MAXIMUM DEMAND

By C. G. ROUSH and R. W. STROMER
Industrial Engineering Dept., Westinghouse Electric & Mfg. Co.



Graphic wattmeter with alarm contacts installed at lower left-hand corner of panel

SOME method of controlling power costs has become a vital necessity in all industries during the past few years of curtailed operating schedules. Electrical costs where power is purchased may be divided into an energy charge and a demand charge. The energy charge varies with the amount of power consumed as measured by the watt-hour meter. The demand charge changes with the kilowatt capacity required. It represents 45 to 85 per cent of the total power bill, depending upon the ratio of maximum kilowatt demand to average kilowatt load.

To reduce the demand charge, maximum kilowatt demand and average kilowatt load should be held as nearly equal as is practical for each individual plant. This will produce a load factor comparable to that obtained during full-time plant operation and thus reduce the cost per kilowatt-hour. Various combinations of integrating-demand watt-hour meters with alarm contacts have been tried for limiting the demand. These, however, are not suitable when plant operations are such that major machines must be in service continuously. They also do not meet requirements when the plant consists of several independent departments which can be operated separately, unless an indicating wattmeter is used in addition to the demand-metering equipment.

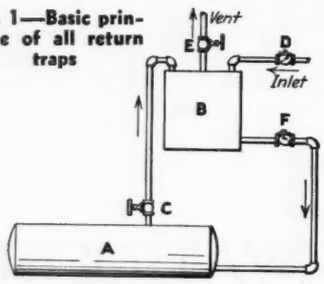
As an example of this type of operation, take a small plant where it is desired to limit its maximum 30-min. demand to 100 kw. Assume that this plant is operating with a load of 80 kw. and additional machines, or another department is added requiring a capacity of 40 kw. This will bring the total capacity required to 120 kw. Also assume that this load is added at the beginning of a demand interval. An integrating meter only will give the operator no indication that the 100-kw. load has been exceeded by 20 kw. until the alarm sounds after 25 min. of the 30-min. interval has elapsed. It will then be necessary to shut down the plant for the remaining five minutes to maintain an average 30-min. demand of 100 kw. This complete 5-min. shutdown would be impractical for most industries and would result in a sizeable loss of production.

This illustrates the necessity of having some form of direct kilowatt indication at all times. A graphic wattmeter with alarm contacts has been developed that meets the necessary requirements for controlling maximum demand. Damping of this meter is such that its pointer will not completely follow momentary motor-starting surges, but the pointer's inertia does not affect its accuracy. The alarm contacts have a capacity of 200 watts at 110 volts alternating-current and can be set at any point from zero to full scale. With an auxiliary relay, alarm signals can be located at strategic points throughout the plant.

This meter with a strip chart gives a permanent daily record of operating condition, or can be used periodically for making detailed load studies of various departments or groups of machines. These records provide definite information as to capacity required by various units in the plant. It is then simple to set up a schedule of operations combining various groups or departments, which will result in best efficiency and yet stay within the predetermined demand limit.

The photo shows one of these meters installed on the control panel of a flour-mill main drive, but connected to indicate the total mill load. This meter has enabled the mill superintendent to reduce the maximum 30-min. demand from 140 to 120 kw. without reducing production, thus lowering kilowatt-hour cost and reducing the power cost per unit of output.

Fig. 1—Basic principle of all return traps



an A.B.C. of RETURN TRAP OPERATION

Types . . . Uses . . . Applications

FEEDING boilers is only one, though perhaps the most important, application of return traps. Among the many other uses are returning condensation of distant buildings to the boiler house, draining vacuum systems, pumping and metering.

All return traps operate on the same principle. From the diagram in Fig. 1 this operating cycle can be easily seen. *A* is a boiler drum and *B* a tank 4 to 6 ft. above the water level in the boiler drum. Condensate returns through the check valve *D* and into the tank *B*, valve *E* in the vent line being open. When tank *B* is full, valve *E* is closed and steam valve *C* is opened, admitting boiler pressure to the space above the water surface in the tank. This forces check valve *D* to close and check valve *F* to open, allowing the water in *B* to flow down into the boiler drum.

To feed a boiler the trap must be above the boiler drum. In actual return traps, valves *C* and *E* are automatically operated when the tank becomes full and again when it becomes empty. Check valves *D* and *F* are used with the actual trap as indicated in Fig. 1, though they frequently are not a part of the trap when it is purchased.

All condensate and drains should first be collected in a receiving tank. This gives the condensate a place to flow while the return trap discharges into the boiler. The receiver should be so placed that all the water to be fed to the boiler will drain into it. In most boiler rooms it will be necessary to elevate the water from the receiver tank to the return trap above the boiler. When pressure in the return system is too low to lift the water, a second return trap is installed to raise it to the return trap above the boiler.

Advantages of Return Traps

Advantages claimed for return traps over steam or motor-driven pumps are: first, a saving in heat because the condensate may be kept at a higher pressure and temperature than is possible when this condensate is returned to an open hotwell; second, little steam is used for pumping and its heat (except that lost by ratiation) is returned to the boiler; third, moving parts are few and simple.

Capacity depends on the size of inlet and discharge, the resistance to flow of water offered by the trap passages, and the difference between actual steam pressure and discharge pressure.

In the case of a return trap feeding a boiler, the elevation of the trap above the water level of the boiler provides the head for forcing the water into the boiler drum and greatly influences the capacity of the trap.

Return traps are rated in pounds per hour discharged when operating with a specified pressure differential. Consequently, it is important to install the return trap to comply with the conditions given in the manufacturer's rating or to adjust trap capacity to the conditions under which it will operate. When specifying return traps for feeding boilers, drum pressure, maximum pounds per hour which the trap may be expected to deliver, and elevation above boiler drum should be given.

Fig. 2—Transverse and longitudinal section of a typical tilting trap

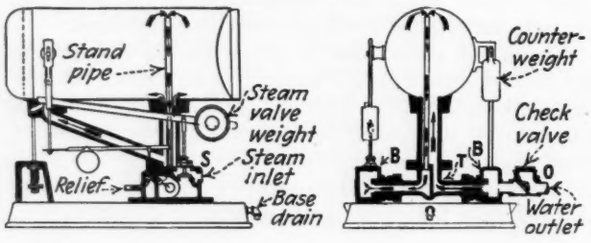
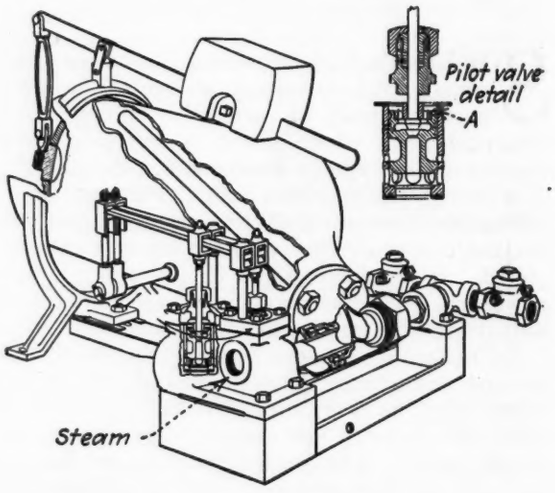


Fig. 3—Trap equipped with pilot-operated valve, with enlarged cross-section of valve mechanism



The frequency with which the trap operates depends on the volume of the trap tank; with a large tank the trap operates less frequently. Traps are usually rated for from 25 to 60 operations per hour. Traps for larger capacities usually operate less frequently.

Return traps are built in sizes ranging from ½ in. to 4 in. diameter of the discharge valve. A 4-in. trap set 4 ft. above the boiler will have a capacity of about 28,000 lb. per hr. Traps are built for pressures up to about 250 lb. per sq.in.

Return traps may be classified as: (1) tilting traps; (2) float traps. In the tilting trap the receiver tank is mounted on trunions so arranged that when the trap is filled with water it tilts, thereby operating the vent and steam inlet valve. In the float trap a float-operated lever operates the valves. In both types the valves are outside of the trap tank, easily accessible for grinding or other repairs.

Fig. 2 is a transverse and longitudinal section of a typical tilting trap. The tank is supported on a hollow Y-casting or pipe fittings which terminate in a hollow trunnion about which the tank tilts. In the illustration

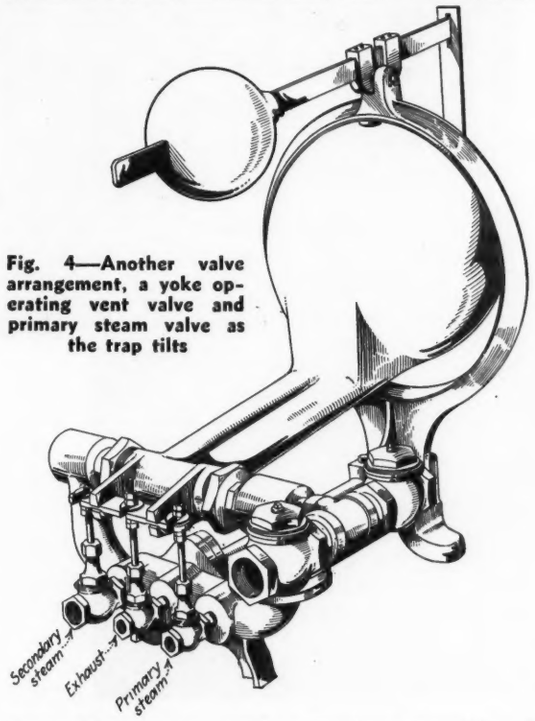


Fig. 4—Another valve arrangement, a yoke operating vent valve and primary steam valve as the trap tilts

the tank is empty, and in a horizontal position, held in this position by counterweight *W*. In the horizontal position the vent valve is open and the steam valve closed. When the tank is full, the counterweight overbalances and the tank tilts, closing the vent valve and opening the steam valve. Condensate enters and discharges through the hollow trunnion and casting. Steam enters through the center standpipe and goes nearly to the top of the tank. This pipe also carries the vented steam. Operation of the linkages for opening and closing the vent and steam valves is obvious from the drawings.

Some manufacturers use pilot-operated valves on their traps. Fig. 3 shows a trap equipped with a pilot-operated valve, the enlarged cross-section showing details of the valve mechanism. The main valve is held open by pressure under the valve disk. When the pilot valve is closed, pressure builds up in space *A* above the main valve, forces the main disk shut. When the trap opens the pilot valve, pressure is relieved in space *A* and the steam pressure under the main disk forces the valve open. Another valve arrangement is shown in Fig. 4. Here when the trap tilts a yoke operates the vent valve and a primary steam valve admitting steam to the trap tank. As soon as the pressure in the tank has built up to within 15 lb. of the initial pressure, the unbalanced pressure opens the secondary steam valve. When the trap is emptied the yoke closes both steam valves and opens the exhaust.

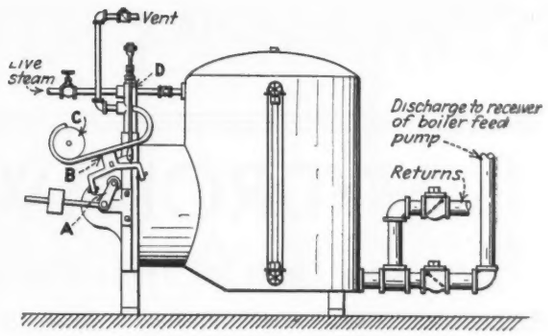


Fig. 5—Valve-generating mechanism of a non-tilting float-operated return trap

When return traps are used to return condensate from high-pressure equipment such as high-temperature cookers, laundry equipment, etc., the condensate is discharged by the non-return traps at a temperature corresponding to the steam pressure. If full thermal advantage is to be obtained in the use of return traps, pressure in the condensate return mains should be kept as high as possible to keep the condensate from flashing into steam. Of course, a certain pressure drop must be permitted to cause the flow of condensate to the receiver. To maintain this pressure a safety or relief valve should be installed on the trap vent, adjusted to operate at a pressure low enough to permit condensate to drain into the trap.

Economical and satisfactory performance of return traps depends upon keeping the valves steam-tight. A tight trap can be used as a meter by installing a counter.

Much attention has been given to the design of stuffing box and trunnion bearings. Stuffing boxes must be reasonably tight, while at the same time offering as little friction as possible so that the trap will tilt freely when water level reaches the desired level in the trap tank. Some manufacturers use ball bearings on the trunnions; others use nickel-plated sleeves.

Each manufacturer has his own particular kind of packing which he feels is best for his trap. In general, it is best to follow his recommendations both as to kind of packing and directions given for installation. Too frequent operation of the trap will cause bearing and packing wear, whereas too infrequent operation of the trap may result in a sticking trunnion.

Non-tilting Return Traps.

The non-tilting return trap operates on the same general principle as the tilting trap, but the trap tank remains stationary. A float inside the tank is connected to a lever arm which operates the steam and vent valves.

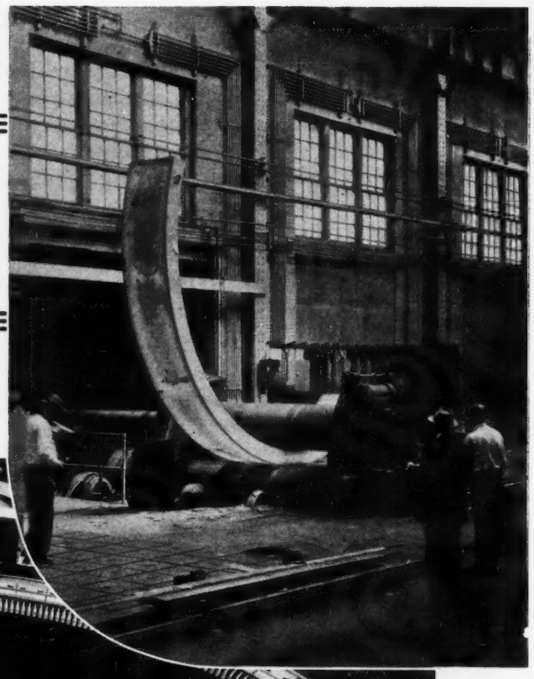
Fig. 5 shows the valve-generating mechanism of a non-tilting float-operated return trap. The float in the trap body operates the lever *A*. The lever *A* engages with rack *B*, moving it to a horizontal position just before the trap becomes full or empty. As the rack moves past the horizontal, weight *C* rolls to the other end and its impact turns the rack, operating the steam and vent valves through lever *D*. A somewhat similar valve-operating mechanism is used in another trap, except that a weight at the top end of a vertical lever is substituted for the rack and rolling weight.

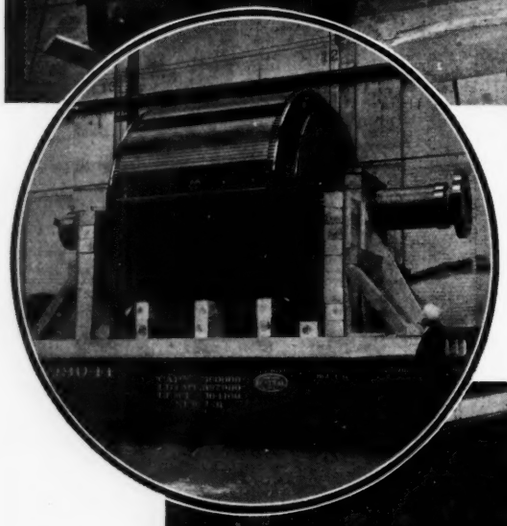
Manufacturers who have contributed information for this article are: Bundy Steam Trap Co., Crane Co., Morehead Mfg. Co., Nason Manufacturing Co., Templeton Bros.

HYDRONEWS

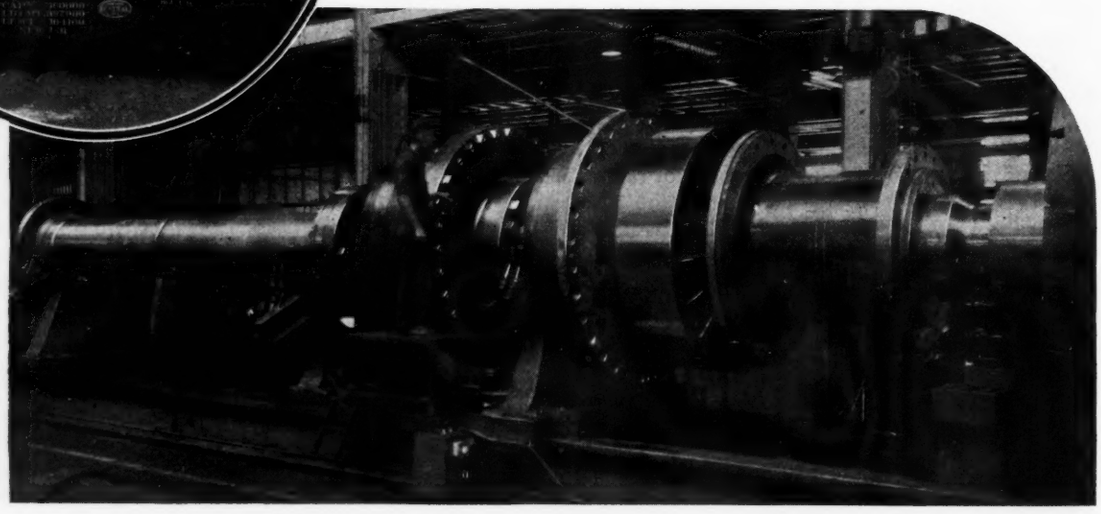
Four Units for Three Projects

Photographs courtesy General Electric and Westinghouse





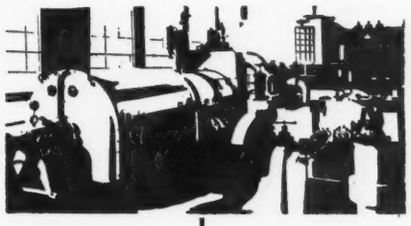
UPPER right is one of twelve 27-ft., 15-ton, half-sections of generator rim being rolled for Kanawha's six new units. Just above, stator frame sections are being bolted together into a 40-ft., 2,000,000-lb., 82,500-kva., generator for Boulder Dam. At left is a 325,000-lb., 31,250-kva. generator rotor on its way to Safe Harbor. And below is the main shaft of the world's largest 25-cycle single-phase generator, rated at 35,000 kva., also destined for Safe Harbor. The two latter units will supply power to the newly electrified New York-Washington line of the Pennsylvania.



IS BYPRODUCT POWER MISNAMED?

"YES"

Says F. C. DEWEESE



"NO"

Says PHILIP W. SWAIN

YOU hear a lot of talk among engineers, sales engineers and operators, and also see quite often in the press, the expression "byproduct power," meaning power produced in the high-pressure stages of extraction turbines by bled steam, or in non-condensing turbines by the steam before it goes to process.

Lumber and Sawdust

A byproduct is something produced during a manufacturing process, other than the manufactured article itself. For example, sawdust is a byproduct in a sawmill; lumber cannot be manufactured without the production of sawdust. On the other hand, electric power which may be produced by bled steam is not necessarily a function of the manufacturing process. It is true that this power is produced during the process of pressure reduction of the steam, but the steam could be reduced in pressure by passing it through an ordinary reducing valve and still retain the heat which would otherwise have been turned into work by the turbine—and this heat would be available for processing.

This is not at all an argument against the modern method of producing power by bled steam, but is written to call attention to the erroneous impression which persists in the minds of many operators that this power costs practically nothing. The fuel cost of power produced by bled steam is low, but is not by any means negligible.

Assume for the sake of argument, the following conditions:

Throttle steam at 250 lb. abs. and 100 deg. F. superheat, extraction pressure 30 lb. abs., internal efficiency of the high-pressure end of the turbine 72 per cent.

The heat in the steam is approximately 1,262 B.t.u. per lb. and the heat turned into work in the high-pressure end is 9.9 per cent of the total heat, or 125 B.t.u. per lb. of steam. The heat equivalent of 1 kw.-hr. is approximately 3,415 B.t.u. Therefore, the water rate is equal to $3,415/125 = 27.2$ lb. per kilowatt-hour.

Assume, further, that the heat content of the coal is 14,000 B.t.u. per lb. and the evaporation 8 lb. water per pound of coal. Then the heat in the coal required for power produced by bled steam is 4,720 B.t.u. per kw.-hr.

Term Misleading

The writer believes that engineers should refrain from using the term "byproduct power" when discussing extraction turbines, as this leaves, at once, in the mind of the average mill operator, the impression that power produced by bled steam costs practically nothing, whereas the true fuel cost of such power is usually from 15 to 25 per cent of that for power produced in condensing turbines.

WE HAVE thought a bit about this ourselves. *Power* has consistently used the term "byproduct" for years. Now and then some reader feels that the term is not quite justified and writes in about it. It's a fair point, so let's discuss it.

Pork and Lard

As Mr. DeWeese says, power cannot be a byproduct in the same absolute sense as sawdust. But look further. Lard is considered a byproduct of the manufacture of pork, yet you can produce pork without making lard. Both the general use of the term and Webster's dictionary definition permit "byproduct" to mean a product that requires some working up at some cost. More often than not, industrial byproducts cost something in finished form, although much less than they would cost if the factory were run to produce them alone.

Now let's turn to "byproduct power." The fuel cost of byproduct power is always less than 25 per cent of the fuel cost of the total steam supplied to the engines or turbines. The factory must make steam in any case, but the generation of power is a matter of choice; hence we call the power the byproduct, although some have argued that exhaust steam is a byproduct of power generation. All agree with Mr. DeWeese that the fuel heat chargeable to byproduct power is around 4,000 or 5,000 B.t.u. per kw.-hr.

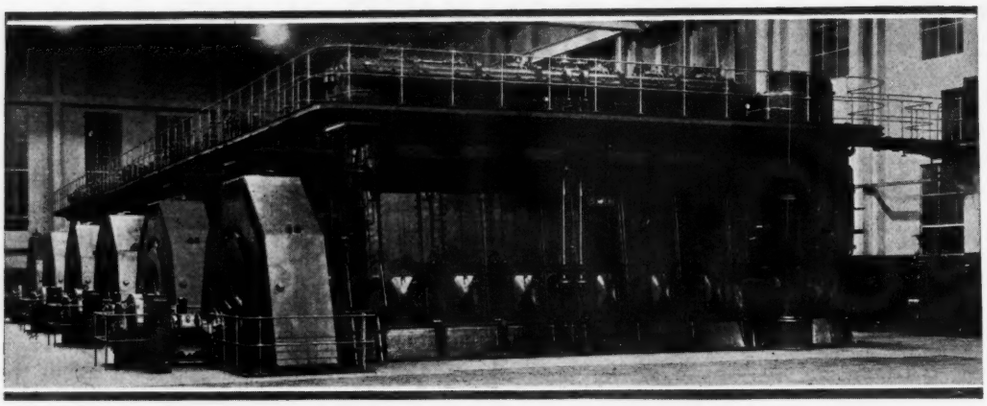
Steam Takes a Ride

The actual steam rate of a turbine may be 30 lb. per kw.-hr., but this does not mean that the turbine *consumes* 30 lb. of steam per. kw.-hr., any more than a railroad train *consumes* the people that ride on it. Regardless of the steam rate of the turbine, whether it be 20 lb. or 60 lb per kw.-hr., the steam consumed in byproduct power generation is close to 4 lb. per kw.-hr., allowing about 1,000 B.t.u. per lb. of steam—call it 5 lb.

One might try to argue against this on the basis that no steam is *consumed* at all; the weight of steam leaving the turbine is equal to the weight entering. Yet, after all allowances are made it will be found that the falling off of the heat in the steam going through the turbine requires the boiler to deliver additional heat equivalent to about 5 lb. of steam per kw.-hr. generated.

Byproduct power is never *free*. I agree with Mr. DeWeese that every effort should be made to kill this fallacy. Where all the exhaust is utilized the cost of the byproduct produced is: Cost of 5 lb. of steam multiplied by the kilowatt-hour output, plus fixed charges, labor and supervision, maintenance and supplies assignable to equipment installed solely for the purpose of generating byproduct power.

Conclusion: I agree that byproduct power is not free. I do not agree that the term is misleading.



Broken Hills Station, New South Wales

HOT SPOTS

IN DIESEL PLANT OPERATING LOGS

ANNUALLY the Diesel Engine Users Association of Great Britain publishes an exceptionally complete report on Heavy-Oil Engine Working Costs. The report submitted before that group Jan. 17, 1934, and just published, contains a vast amount of information of interest to diesel engineers everywhere. The following abstracts are salient points from the report, dealing principally with maintenance.

Returns cover 54 electrical generating stations and 9 waterworks plants. Broken Hills, N.S.W., station, described some time ago in *Power*, a 22,800-hp. station, reports the high load factor of 30.8 per cent for peak-load work. Lubricating oil consumption is only 7,900 rated b.hp.-hr. per gal. When this station's abnormally high prices for fuel and lubricating oil are reduced to English price averages, fuel cost is 0.196, lubricating oil 0.004, stores and water 0.010, wages 0.027, repairs and maintenance 0.019, a total of 0.256 pence (penny is 2 cents U. S.) per kilowatt-hour.

Repairs and maintenance cost 0.087 pence for home stations (average) and 0.065 for overseas stations reporting, as compared with 0.096 and 0.085 last year. This makes average cost for repairs and maintenance, including labor, 0.073 pence, a decided reduction from the 0.180 of eleven years ago. Average cost per rated kw.-hr. run for repairs and renewal (excluding own labor) for 13 stations has averaged 0.0284 pence for eleven years. Crompton Station for the same period has the exceptionally low figure of 0.0029 pence.

A number of operating engineers have sent in specific comments having to do with lubricating oil consumption, repairs and maintenance. The following are abstracts:

Pearson, Shanghai Waterworks Co.: We propose fitting larger oil coolers to our No. 17/18 Allen 4-cycle set in an attempt to reduce the temperature of circulating lubricating oil, as we think that in these sets a contributory cause of higher lubricating consumption is the higher temperature in the circulating system. . . . All exhaust valves are changed after over 500 hr., all fuel and inlet valves after 1,000 hr. In air-injection engines, compressor valves are changed after 170 hr. run. . . . Regular routine overhauls are carried out after 3,000 running hr. After each overhaul test trials are carried out, but we rely mainly on exhaust gas temperatures to indicate even distribution of power between cylinders and satisfactory running.

In April, 1932, our large 2-cycle engine was stopped for overhaul, and on inspection it was found that three pistons were slightly cracked and had to be condemned. We have had several seizures on the engine and at the same time had only one spare piston in Shanghai. We found it necessary, therefore, to cast two new pistons locally, and due to the necessity for carrying out repairs quickly, heat-treatment was resorted to in place of the usual "weathering." We have deemed it advisable gradually to increase clearances on pistons to an additional six thousandths of an inch above maker's figures, and this additional clearance has undoubtedly resulted in a smoother running engine. For the last twelve months we have had no further seizures. Locally cast pistons appear to be entirely satisfactory. . . . In addition, four spreader throats were found cracked, and we consequently fitted four new locally made throats of 3 per cent nickel steel. These appear to be entirely satisfactory. We are of the opinion that the cause of the cracked spreader throats was due to makers having used jointing of graphite between spreader throats and casings which formed an insulation barrier sufficient to prevent free distribution of the heat generated.

H. Austin Palmer, South West Suburban Water Co.: 20,500 rated b.hp.-hr. run per gal. of lubricating oil. Engines and gear oils are filtered through a streamline renovator and re-used, but a small quantity of fresh oil is added for cylinder lubrication only. Figures of oil consumption are therefore low and are based on makeup.

C. W. Bennett, Chester Waterworks: RENEWALS OF PARTS. *Cylinder Liners*—Engine 1, full set after 18,225 hr., again after 51,980 hr., since run 6 hr. Engine 2, full set after 28,771 hr., since run 33,579 hr. Engine 3, no renewals with 47,247 hr. run. *Pistons*—Engine 1, full set heads only after 3,876 hr., again after 14,349 hr. Full set solid pistons after 51,980 hr. Since run 6 hr. Engine 2, full set pistons after 28,771 hr., again after 8,348 hr. Since run 25,231 hr. Engine 3, no renewals with 47,247 hr. run. *Cylinder Heads*—Engine 1, one head after 5,025 hr. Since 65,186 hr. Other two heads 70,211 hr., still good. Engine 2, no renewals to date after 63,350 hr. run. Engine 3, no renewals to date after 47,247 hr. run. (Cooling water has an average of 8 deg. of hardness.) *Crankshaft Rebedded*—Engine 1, after 11,809 hr. and again 9,832 hr. Since 48,570 hr. Engine 2, not required after 63,350 hr. run. Engine 3, not required after 47,247 hr. run. (Engine 1—150 hp., 3 cyl., 12x18¼ in., 250 r.p.m. Engine 2—200 hp., 4 cyl., 12x18¼ in., 250 r.p.m. Engine 3—200 hp., 3 cyl., 15x22 in., 180 r.p.m.)

R. S. Hull, Ilfracombe (continuing reports on "closing in" of cylinder liners in way of rubber rings sealing bottom end of liner water space): We consider closing in to be through growth of rubber rings and/or scale settling between liner and column band above the rubber ring (though there was very little evidence of the latter). . . . Load and temperature tests were made on an unsuitable oil which almost produced piston seizure (on opening the line, piston and liner walls were gummed up with a sticky yellow film). The ——

curves, Fig. 1, show the rapidity with which exhaust temperature increased relatively with load. In comparison the ---- and —— curves (representing tests on two engines) show considerably reduced and steady maximum temperatures on a more sustained load—an object lesson in the necessity for careful choice of lubricating oil.

T. M. Clay, Pahang Consolidated Co., Ltd.: Your committee might be interested to know that I have cut lubricating oil costs considerably recently in the 4-cycle mechanical injection M.A.N. engine by using a very viscous oil for piston lubrication (Viscosity 31 Engler at 50 deg. C.). Wear on wiper rings since using this oil has been very slight indeed, exhaust gases are now colorless, and pistons when withdrawn are very clean. When using a lighter oil (10.5 Engler at 50 deg. C.)

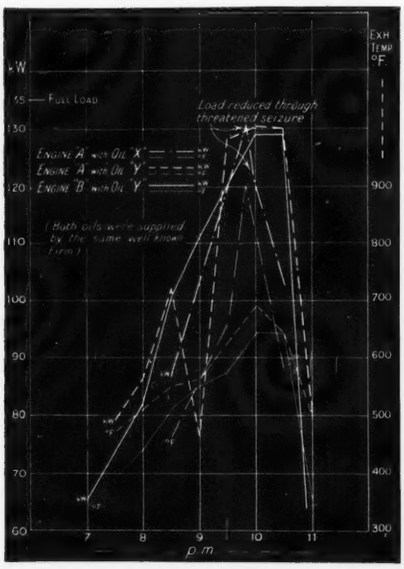

kW
EXH TEMP °F
Load reduced through threatened seizure
Engine 'A' with Oil 'X'
Engine 'A' with Oil 'Y'
Engine 'B' with Oil 'Y'
(Both oils were supplied by the same well-known Firm)
p.m.

Fig. 1—Rapid increase in exhaust temperature with load when burning an unsuitable oil at Ifracombe Station

exhaust gases had a bluish tint and wear on the wiper rings was considerable, resulting in high lubricating oil consumption. . . . Heavy wear on exhaust cams had also been a source of trouble in this engine, and as the cam shaft was one 24 ft. 9 in. in length, changing of a cam would entail an enormous amount of work. I therefore made split cams, held together with cotters and cotter bolts, but as the makers did not favor this method, I decided to arc-weld them, where worn, using nickel cast-iron welding rods; this has stood up to its duty quite well for the past 60 days running. . . . We have had entire satisfaction with cams so fitted to two 200-hp. engines running at 185 r.p.m. . . . With the Sulzer 2-stroke 1,400-hp. diesel, we have experienced considerable trouble with broken piston rings. This occurs regularly with either the top or second ring, and although the broken pieces, which pass to the air intake of exhaust pipes, do not appear to damage the piston or liner, there is no knowing when trouble might arise from this source. I have tried chamfering the edges of these rings, slightly increased clearance between ring ends, and increased lubrication, but without satisfactory results. Loads on each piston are balanced whenever the engine is first run up to load after having been overhauled or shut down. The engine in other respects gives perfect satisfaction at all loads.

W. A. Dingle, Mid North Electricity Co.: All lubricating oil successfully treated on the coagulation principle and brought back to almost its original color. Cost of treatment for alumina sulphate and current used 0.67 pence per gal.; 1.1 per cent losses. Abnormally high maintenance costs principally due to the failing of the human element. Skilled engineers are now displacing drivers with the advent of modern machinery.

Mr. Aspley, Indian Radio Telegraph Co.: Regarding general wear, our original set of liners ran some 20,000 hr. The original pistons were of an aluminum alloy. These failed, owing to the piston ring grooves not standing up to the cast-iron rings. Big end bearings crack, but these have been better since fitting copious lubrication to them. Our engines are normally run continuously for one week.

E. L. A. Mathias, M. R. Tel. Co. of Egypt: Our engine, after overhaul, was assembled and run 113 hr. on load apparently quite satisfactorily, and then a partial seizure of No. 2 piston occurred. Serious damage was prevented by prompt action of the staff. No satisfactory explanation is forthcoming, but here are some of the suggestions: Possibly the piston was replaced after a 180-deg. turn. Possibly it was because the bottom liner jointing was not holding (but this may have been caused by the heat developed) and the water spray impinging on the pis-

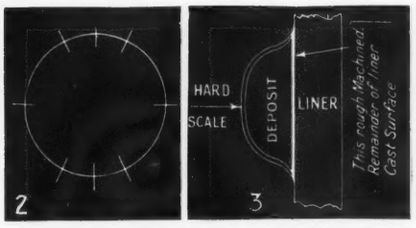


Fig. 2—Points of partial seizure. Fig. 3—Scale formation on Egyptian engine

ton washed off the lubricating oil. The jointing ring was definitely destroyed at one of the points of partial seizure, which were as shown in Fig. 2. . . . A point of interest is the scale formation on the liner. This was approximately $\frac{1}{64}$ in. on top and bottom of the liner. This scale was hard and had to be chipped off. In the center of the liner, however, there appeared a band of soft deposit with the hard scale on the outside, the thickness of deposit and scale being about $\frac{3}{16}$ in. and the band with 6 in., as in Fig. 3. Cooling water is Nile water containing a large amount of very fine sediment (for 5 mo. of the year) which does not settle completely even after two days.

Mr. Mathias' diesel superintendent included the following report of this seizure: Engine was started at 0930 hr. At approximately 1115 hr. engine started to labor, emitting a characteristic whine. I immediately tripped main switch and shut the engine down. A laborer was immediately put to work barring the engine round and the system flooded with oil from the hand priming pump, meanwhile inspection doors were hurriedly removed and it was discovered to be No. 2 piston that had commenced to seize up. Piston was liberally douched with warm oil, at same time barring round in order to keep hot surfaces apart and free. All bearings were cool, as were Nos. 1 and 3 pistons. In the desperate hurry to shut down, oil gage reading was not noted. One hour after shutting down, a very slight water leak from the bottom joint of liner was noted. After engine had cooled down, cover was lifted and piston withdrawn, considerable strain being put on tackle to draw the piston out, although the engine had barred round normally freely. Examination of the piston showed the seizure was taking place at eight distinct points around the piston, apparently commencing to seize at the skirt and extending to the piston pin cover plates. The piston body above this point showed only slight abrasion. The most serious points of seizure occurred on opposite sides of the piston on the CL of the engine, at which points the casting was badly gouged and scored, points of seizure on the across diameters occurring as three separate and distinct abrasions on each side of the piston were not too serious, appearing as shallow scores and heavy discoloration due to frictional heat. The liner also suffered to the same extent, being heavily scored on the CL diameter, but fortunately only lightly over the surfaces traversed by the rings. The pump was drained of oil with a view to ascertaining the extent of any water leak, but no trace of water was discovered. No. 2 big end has been lowered for inspection and found O.K., small end brasses and pin also examined and found O.K. Mechanical lubricators were tested and found to be working O.K.; condition of upper portion of piston and rings bears this out. My personal opinion of the cause of seizure is: The liner, being free to expand longitudinaly, in its continual expansions and contractions caused minute fractures in the bottom jointing ring, permitting minute sprays of water to be ejected on to the piston skirt as this latter overran the liner. This is borne out by the distinct points of well-defined contact and the normal brightness of the piston between the lines of seizure. The discolorations are definitely local and confined to approximately 1-in. bands, not as is usually the case—large and irregular contacts. However, this liner must certainly be removed and the joints renewed (bottom joint rubber, top asbestos).

V. C. Botham, Ruthin Electricity Supply Co., Ltd.: Mirrlees engines now fitted with copious lubricating gear; all rockers lubricated with light grease which entirely prevents seizing of rockers and formation of rust.

P. D. Webb, Burma Electric Supply Co., Ltd.: Excellent results during the last four years from the cleaning of diesel fuel oil by centrifuge. Liner wear is less and exhaust valves require less cleaning. Double-seal piston rings in use in all engines with extraordinarily good results. Cylinder lubrication is much improved and liner wear approximately 0.001 in. per 1,000 hr. Great benefit from softening and filtering cooling water.

WELDING

— Handy Power Plant Tool

Metal Congress and Exposition, including annual meeting of American Welding Society, held for first time in New York, include much of interest to power engineers

MEETING for the first time in New York, the National Metal Congress and Exposition raised attendance and interest to record proportions. American Welding Society, holding its fourteenth fall meeting at the Hotel New Yorker, had a number of papers of particular interest to power engineers.

The Exposition, held the week of the Congress, Oct. 1-5, at the Port Authority Building, included about 140 exhibits, many devoted directly to welding processes and equipment.

Among Welding Society inspection trips were the new Midtown vehicular tunnel, a large brewery, and a plant featuring welding and cutting. The regular stag dinner boasted an attendance of 250, and J. C. Lincoln, chairman of the board, Lincoln Electric Co., was awarded the Miller Memorial Medal for achievements in welding.

Technical papers of particular interest to power engineers included: "Use of Polarized Light as Applied to Welding Products" (E. W. P. Smith, Lincoln Electric Co.), "Examination of Welds Made Under Field Conditions for High-Pressure High-Temperature Steam Piping" (D. H. Corey, Detroit Edison, and A. E. White and C. L. Clark, University of Michigan), "Sprayed Molten Metal Coatings" (E. V. David, Air Reduction Sales Co.). Participants in a discussion of the methods for qualifying welding operators included W. D. Halsey of Hartford Steam Boiler, Alexander Kidd of M. W. Kellogg, Dr. S. Lewis Land and John H. Zink (pipe welding), J. W. Owens, director, National Weld Testing Bureau.

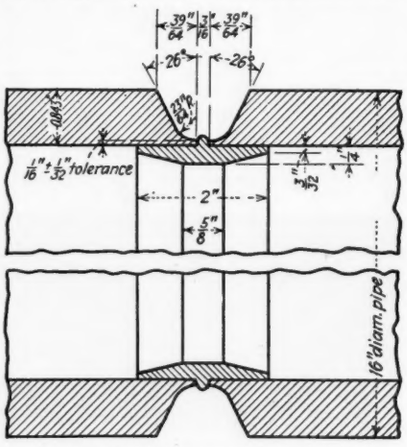
New Polariscope

Mr. Smith's paper gave clear instructions for the construction of a simple and cheap polariscope to examine celluloid models of structural elements by polarized light. The more costly polariscopes ordinarily used for this work contain Nicol prisms. Mr. Smith's design utilizes a polarizing mirror made of several sheets of thin glass with backs painted black. When the models are examined by this instrument the arrangement of colored lines shows immediately the concentration of stress, and indicates where the structure would be likely to fail in practice.

The use of polarized light to examine model specimens is not new, but Mr. Smith's presentation and his description of a simple polariscope should make this method available wherever metal structures or equipment are designed and built.

Detroit Edison Steam Piping

The paper of Messrs. White, Corey & Clark was of particular interest to power men, because it showed full acceptance of welding by one of the best-known utility companies. Detroit Edison is now rebuilding a portion of its Conners Creek plant. The new equipment will



Detroit Edison's design of welded joint for steam at 600 lb. and 850 deg. F.

operate at 650 lb. pressure and 850 deg. F. Fusion welding by the direct-current metallic arc process is widely used for steam piping operating at full boiler pressure and temperature and for boiler feed piping systems operating at 1,000 lb. and 385 deg. The main superheated steam piping uses no flanged joints between the superheater header and the turbine stop valve inlet; all valves between are of the welding-end type.

The decision to use fusion welding to this extent was arrived at only after extensive investigation and proof that sound reliable welds could be produced under field conditions by welders employed by the company's construction department. Preliminary test joints were carefully analyzed by the department of engineering research, University of Michigan. The accompanying drawing shows the design of the welded joint for 16-in. high-pressure lines. Note that an inner chill ring is used to prevent the formation of any welding "icicles" within the pipe. Pipe used in the investigations was 16-in., grade B, Schedule 80 (A.S.A. tentative standard) seamless steel, containing 0.33 per cent carbon, 0.75 manganese, 0.06 silicon, 0.04 aluminum, 0.06 chromium, 0.01 phosphorus, 0.02 sulphur.

In completing the pipe-to-pipe weld, seven beads were deposited. Time required for completion of the weld was approximately 16 hr. The pipe-to-casting weld (corresponding to the welding of a pipe to a valve) required approximately 20 hr. Welds were stress relieved by heating a circumferential band containing the weld to a temperature of 1,100 deg. F., holding to that temperature for one hour and cooling in chill air. Electric heating by induction, with which the company was then experimenting, was used.

Sample joints were elaborately tested by X-ray, microscope, tensile tests, impact tests, creep tests and the following conclusions drawn: X-ray examination revealed satisfactory quality, as did examination by microscope. Tensile tests at 850 deg. showed suitable strength and ductility. Impact values were satisfactory. Creep resistance was found to be entirely sufficient.

The paper concluded with the statement that welded steels of the type tested will render safe and satisfactory service under proposed operating conditions.

Spraying Metal

E. V. David presented, in his paper on Sprayed Molten Metal Coatings, much information on this process, which has many possible applications in the power field and elsewhere. Many of these have been described before, but still are not known to all power engineers. Metal is fed to the spray gun in the form of a wire. There it is liquefied by an oxy-acetylene flame and blown by compressed air, in the form of a fine spray of molten metal, on the object to be coated.

Approximately any type of surface may be sprayed, whether it be metal, paper, wood, or fabric. It is possible to spray non-ferrous metal on ferrous metal, and vice versa. The coating of metal is instantly hard, cold and dry, and ready for use. The molten spray has no tendency to ignite or char such organic substances as paper or wood.

A single pass of the spray gun gives a metal coating about one or two thousandths of an inch thick. Wire size and rate of feed are adjusted to suit the metal used. Weight of metal sprayed ranges from about 1.2 lb. per hr. for iron to about 18 lb. per hr. for lead. Area metal-coated to 0.006 in. thickness ranges from 6 sq.ft. per hr. for iron to about 60 sq.ft. for lead. Approximately

23 to 26 cu.ft. of oxygen, 22 to 25 cu.ft. of acetylene, and 2,500 to 3,500 cu.ft. of compressed air are consumed per hr. per gun.

On surfaces properly prepared (preferably by sand blasting) correctly applied sprayed metal coatings are, it is claimed, practically integral with the surface. The coating may be polished, ground, turned, filed or otherwise finished like cast metal. According to Mr. David a 0.006-in. coating developed in four to six passes, will cost (for wire, gas and compressed air) about 18 cents per sq.ft. for iron, 11 cents for lead or zinc, 9 cents for aluminum. These figures do not take into account the "edge loss" in coating small objects.

One application of the process is to increase the resistance of iron or steel parts to high-temperature gases. Parts sprayed with aluminum are then painted with three successive dip or brush coats of potassium silicate and heated to 1,400 deg. F. for 5 min. The temperature is then raised to 1,900 deg. for additional soaking. This produces surfaces effective in preventing scaling from heat, and greatly increases the durability of such parts.

The spray gun may be mounted in a lathe for building up worn shafts which may later be turned or ground to exact size. It is also used for repairing surface defects. The special alumetizing process just described is now being used to protect the surfaces of grate bars and water-wall tubes of boilers.

Testing Welders

Reduced cost by the avoidance of duplicate testing was urged by James W. Owens in his paper. Industry, he said, has not questioned the necessity for preconstruction weld tests. However, increasing costs, due to constant repetition of identical or practically identical preconstruction tests, have created the demand among manufacturers that steps be taken by the American Welding Society to reconsider the entire problem. The Society has appointed two committees for this work.

Basically, two factors affect this cost. One is the non-uniformity of the test, test specimens and test requirements of the fusion welding code required by various technical societies, governmental, regulatory and other bodies. The other is that until very recently practically all governmental departments, insurance companies and regulatory bodies regarded an investigation of a manufacturer's welding process and preconstruction test of his operators as "inspection." Each group insisted on making its own independent investigation.

Mr. Owens outlined methods of establishing the minimum number of tests absolutely necessary for safety. He urged provision for statically stress-relieving so-called "Class 2" welded products, and hammer-shock testing of the joint while the base metal of the product is stressed beyond the yield point.

In his paper, "Qualifying Operators of Welding Equipment Under A.S.M.E. Boiler and Pressure Vessel Codes," Wm. D. Halsey pointed out that the code for boilers and for U-68 vessels does not specify any exact procedure for determining the **ability** of the operators employed in welding the vessel. The code does specify that a sample of welding must be made for each pressure vessel, and in a recent case the Boiler Code Committee stated that the inspector has the right to call for test of any individual operator on a power boiler or U-68 vessel at any time.

Mr. Halsey said that quality welding depends first, upon the development of welding procedure carefully tested and known to produce acceptable results, and, second, that operators must be trained to follow exactly the technique of welding and be subsequently tested to determine their ability to follow the procedure and to obtain results.

He suggested several tests to determine the welder's ability. The free bend test is used primarily to determine the ductility of a welded joint. It is also of value in examining an operator's ability to obtain fusion with base metal. The nick-break test has been used to determine the operator's ability to obtain a clean weld. However, the present type of nick-break specimen, while permitting an examination of the degree of porosity of the weld metal, and the operators' ability to obtain a weld sound at the root, does not permit examination of the operator's ability to obtain thorough fusion with the base metal. To remedy this the author suggested a new form of nick-break specimen.

J. C. LINCOLN WINS MILLER MEDAL

AT ITS annual meeting the American Welding Society awarded the Samuel Wylie Miller medal to John Cromwell Lincoln, chairman of the board, Lincoln Electric Co., in recognition of his contributions to the advancement of the science of electric fusion welding.

An early pioneer of arc welding, J. C. Lincoln has devoted most of his life to research and development of the electric arc as an industrial tool. With Charles F. Brush, inventor of the arc light, in 1888, Lincoln early gained experience with the phenomena of the electric arc. Later he became affiliated with the Elliott-Lincoln Electric Co. In 1896, with this company as a nucleus, he formed the present Lincoln Electric Co.

Under his direction this company produced in 1907 a variable-voltage arc-welding machine. Two years later, as a direct result of Lincoln's efforts, cast iron products were redesigned for arc-welded steel construction. In 1916 Mr. Lincoln carried the electric arc into the structural field. A year later, in conjunction with the U. S. Government, he established a school for training welders.

Still another contribution to the ever-broadening field of application of arc welding was made in 1919 by Mr. Lincoln when the first motor was completely redesigned from cast-iron to arc-welded steel.

In 1929 his company introduced the shielded arc for general industrial use.

FOREIGN POWER NOTES

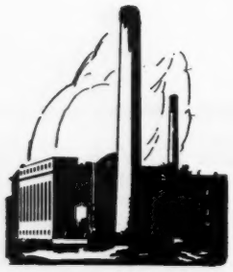
Bridge River power plant of B. C. Electric Railway Co. has put its initial 4,600-hp. generator into operation for drying out and testing, using the new 24-in. welded steel penstock. The 60-ton cylindrical gate controlling intake to the tunnel is to be operated by a 60-hp. motor, but since no power was available for its initial opening, a capstan was rigged and the population of the town mustered to supply the necessary manpower.

Northwestern Utilities, Ltd., holder of the gas franchise at Edmonton, Alta., is planning to expend $126,500 this year on a works program and purchase of new equipment, according to Julian Garrett, manager. Program includes $55,500 of capital expenditure for equipment for maintenance work and some extensions, and $71,000 for field work and maintenance of production and distribution systems.

Vancouver, B. C., is soon to start erection of the first $250,000 unit of a central heating plant, and preliminary work has already commenced, according to Col. E. J. Ryan, Vancouver contractor. Col. Ryan has returned from Tacoma, where he conferred with H. A. Flood, holder of the central heating franchise.

Immediate establishment of a second power unit on Ferguson Creek, B. C., is to be undertaken by Wayside Consolidated Gold Mines, Ltd., with an expenditure of between $25,000 and $30,000. Contract for the dam 30 ft. high and 90 ft. long has been placed with Hodgson, King & Marble, 626 West Pender St., Vancouver. This dam will be of timber and dimension timber construction, with concrete abutments. The power house for the second unit will be built by the mining company, and is to have a capacity of between 400 and 600 hp. It will be located about 600 ft. vertically above the present plant on Ferguson Creek, and will tie into the latter. The power house is to be of frame and galvanized iron construction. Most of the equipment will be bought through the Sullivan Machinery Co., 633 Howe St., Vancouver.

Shawinigan Water & Power Co., Montreal, Que., has authorized an expansion program at hydro-electric generating plant at Rapide Blanc, Que., to include installation of additional equipment to develop a total output of 160,000 hp. It is proposed to have the first unit, making a gross of 100,000 hp., ready for service by next spring, with the next unit, 60,000-hp. rating, available by the fall of next year. Program will run over $750,000.



9 STEPS TOWARD A Modern Plant

By N. T. PEF

IN UNDERTAKING a modernization program which is to extend over a period of several years, it is not essential that every move, both immediate and distant, be definitely mapped at the start, but the first steps are very important. A recommendation for a new boiler or turbine will not likely go through, but a requisition for an Orsat or a draft gage, if these are lacking, will carry without fail, if at all properly made. A draft gage, CO_2 tester, or thermometer is like the first brick in a skyscraper. Move up the scale with additions of more and more importance, all designed with a certain objective, namely, an up-to-date plant in five years. When the time comes for the principal equipment, there will be little resistance to be overcome if the previous steps were successful.

The problem of each power plant is different, but I have found that the following steps, in the order indicated, will serve as a pattern for a modernization program in most plants.

1. *Boiler Room Instruments.* The order of their importance is this: draft gages, thermometers, flowmeters, CO_2 machines, automatic regulators. This class of equipment is especially valuable in reducing fuel costs and pays for itself in a very short time, sometimes in a month. A starting point for a "bare" plant is a testing set consisting of draft gage, flue-gas thermometer and CO_2 tester.

With this set, any engineer worth his salt can cut the fuel bill at least 10 per cent in a few days.

2. *Temperature Control.* Pressure and temperature recorders are valuable and it is well to have them, but modernization should be built on a foundation of quick amortization and only such apparatus should be selected as will clearly reflect in the power cost before the next step is undertaken.

3. *Soot Blowers.* The installation of soot blowers is always a paying proposition. While most boilers have this equipment, I have found that in about half of the cases some elements needed replacement.

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"Half a loaf is better than none." Your ideal plant may be years away, but you can start savings now **with inexpensive equipment and move step-by-step to the goal of complete modernization**

•

4. *Continuous Blow Down.* This equipment is rather young in years but it has not taken it long to demonstrate its value. It is a money saver in all installations where there is appreciable make-up water.

5. *Steam Purifier.* This equipment cannot in all cases show returns in dollars and cents as clearly and quickly as some of the other equipment, but its value cannot be questioned where trouble from dirty steam is experienced.

6. *Economizers and Air Preheaters.* Hardly a station goes up today without either one or both of these fuel savers. For existing plants, and for the usual case, only one of them need be considered.

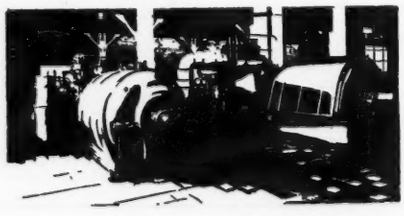
7. *Superheaters.* When many of the older plants were built, the importance of superheated steam was not yet fully appreciated. In many cases the addition of superheaters to existing boilers will cut down the fuel bill considerably. Superheaters are now designed to fit any type of boiler, even the return tubular. Engines and turbines now operating with saturated steam can, without any change, take steam superheated 100 deg.

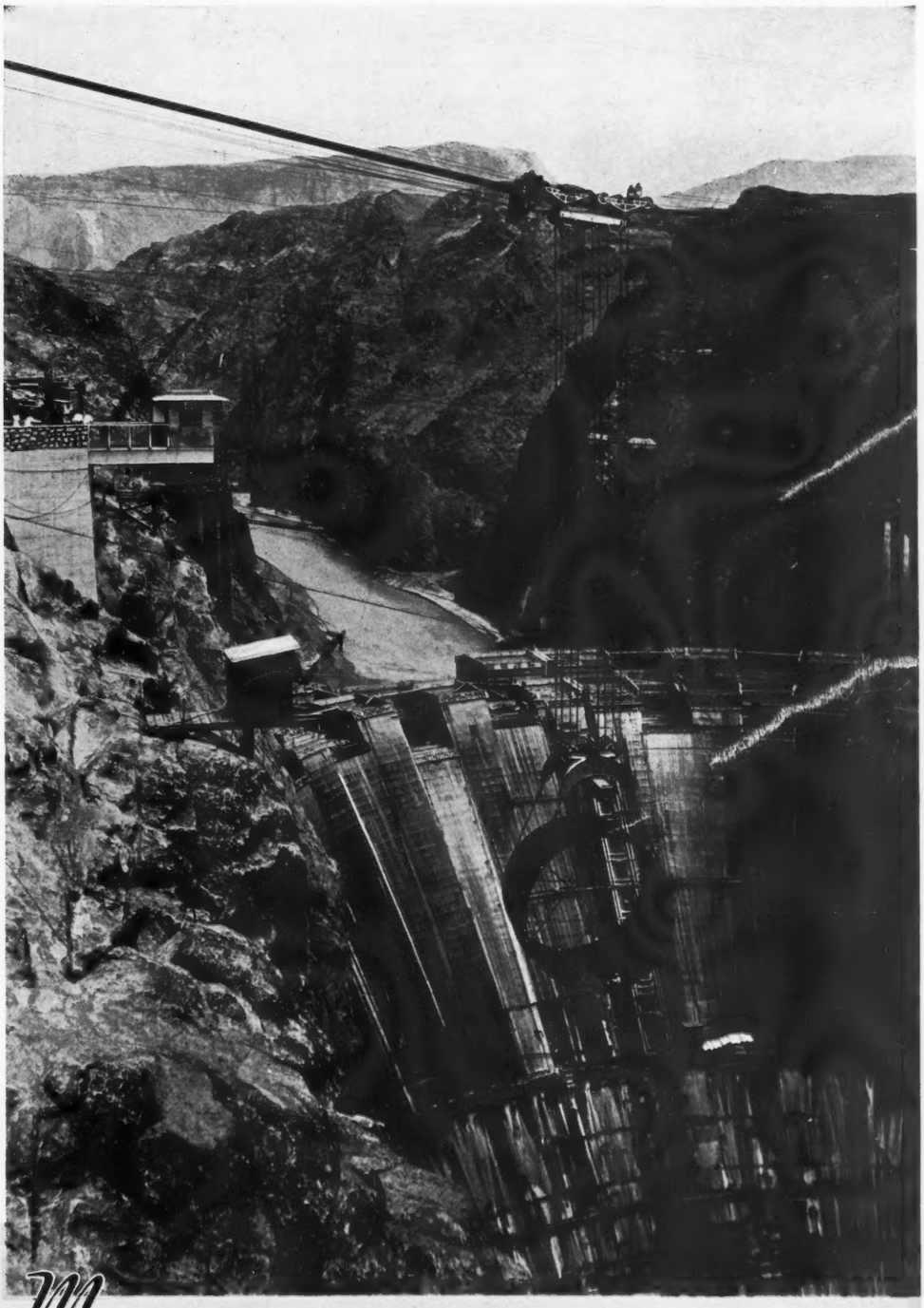
8. *Boiler Capacity.* The capacity of a boiler is practically without limit; if the air and fuel feed is doubled, the same boiler will deliver about twice as much steam as before. All hand-fired installations, and all others that are limited in air alone, can be increased in capacity by the installation of a forced-draft fan. If there is a limitation in fuel, this can be taken care of by a larger stoker or otherwise.

9. *High-Pressure or Low-Pressure Turbines.* A high-pressure turbine ahead of the present units will add many extra kilowatt-hours without an increase in the fuel bill. A low-pressure turbine at the tail end of the present units will do the same thing. If you cannot make use of the extra electricity, consider tying up with a public utility and selling the excess.

The foregoing nine items constitute the preliminary moves and high spots in a step-by-step modernization program to extend over a period of 3 to 5 years.

In my experience I have found it advisable to submit all recommendations in writing in the form of a report. It is most unusual for a recommendation to go through on its first submittance. This is a good thing because it eliminates all proposals of doubtful value. Subsequent reports are analogous to follow-ups in advertising. The same idea is presented in a different light and with additional arguments.

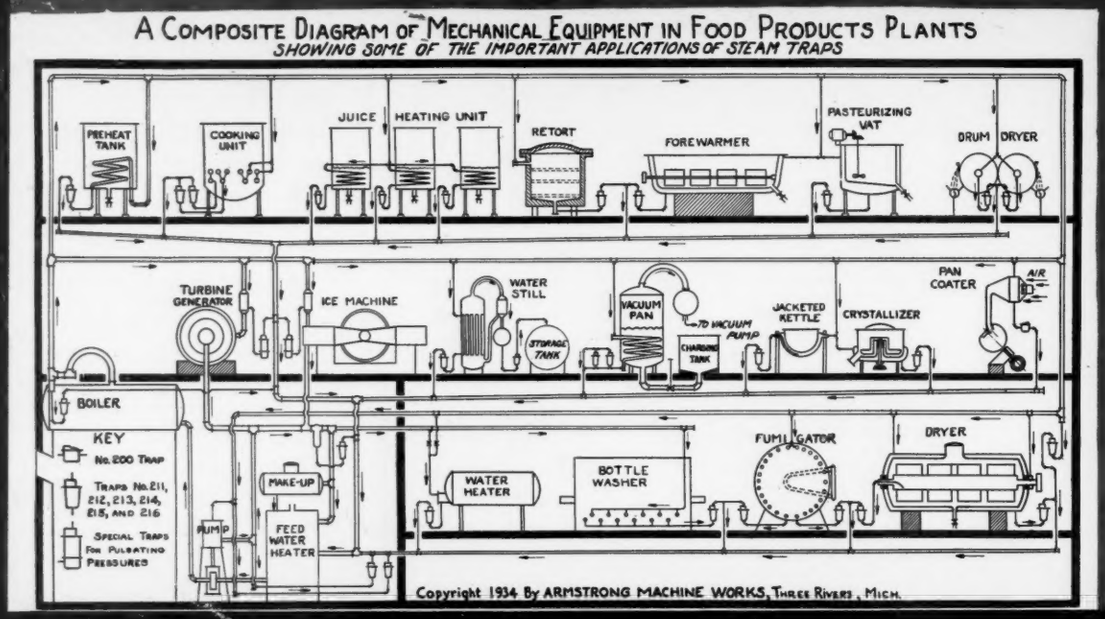




Little Man

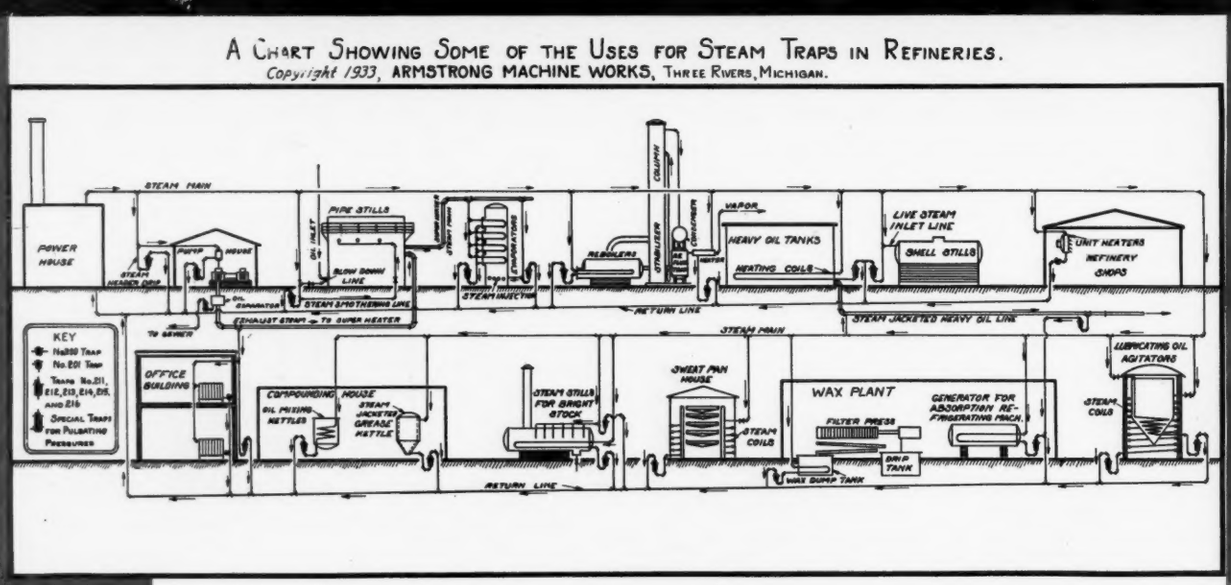
Wide World

The man in the pipe is 6 ft., the pipe 30, the dam 730 —but men conceived Boulder Dam, men are building it, and men will use it. Little man, what now?

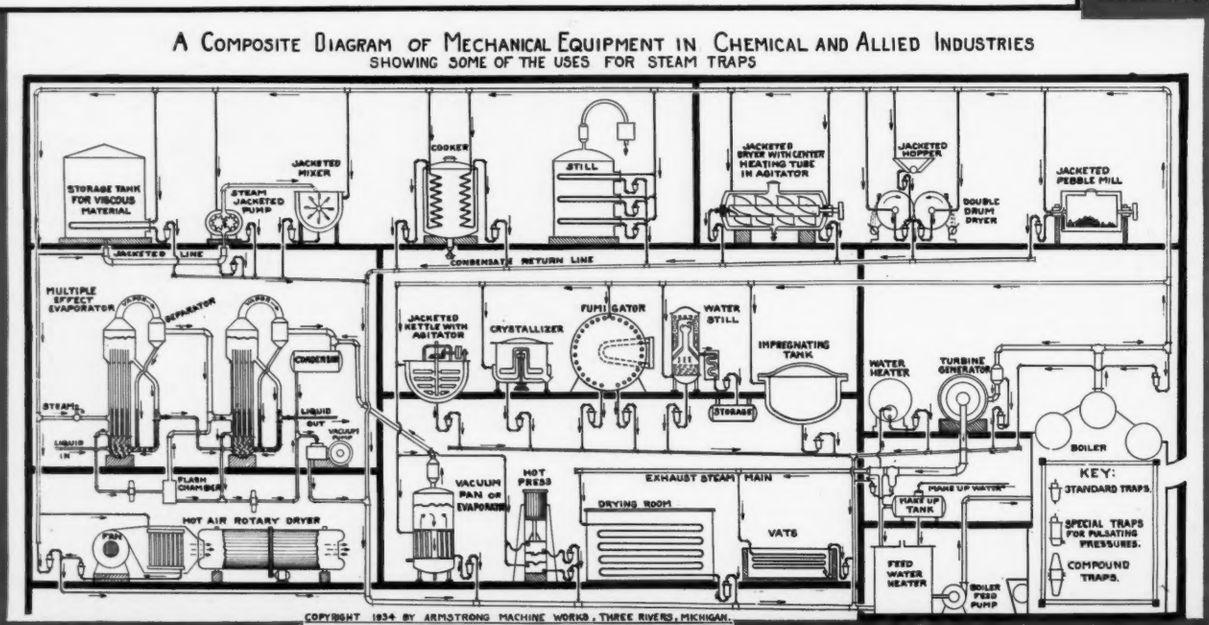


Every application indicated on these charts is one in which Armstrong steam traps have repeatedly demonstrated their satisfactory service. In all these cases—and scores of others—the Armstrong field organization can be of help to you in selecting exactly the right traps for your conditions.

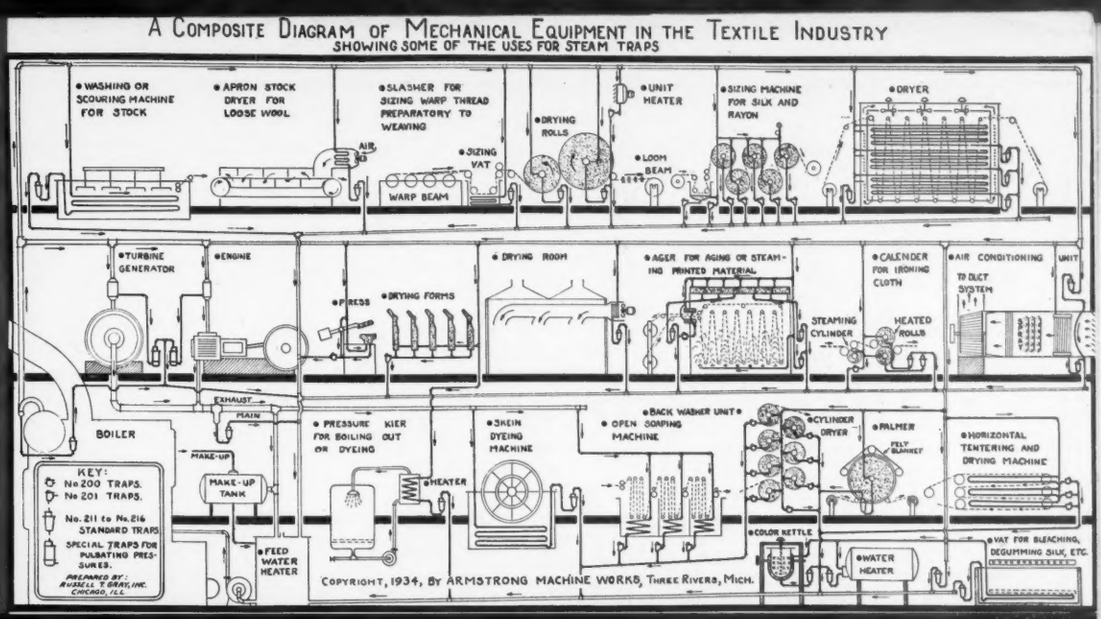
These Six Typical Varied Uses For Traps



These diagrams were compiled by the sales and engineering departments of the Armstrong

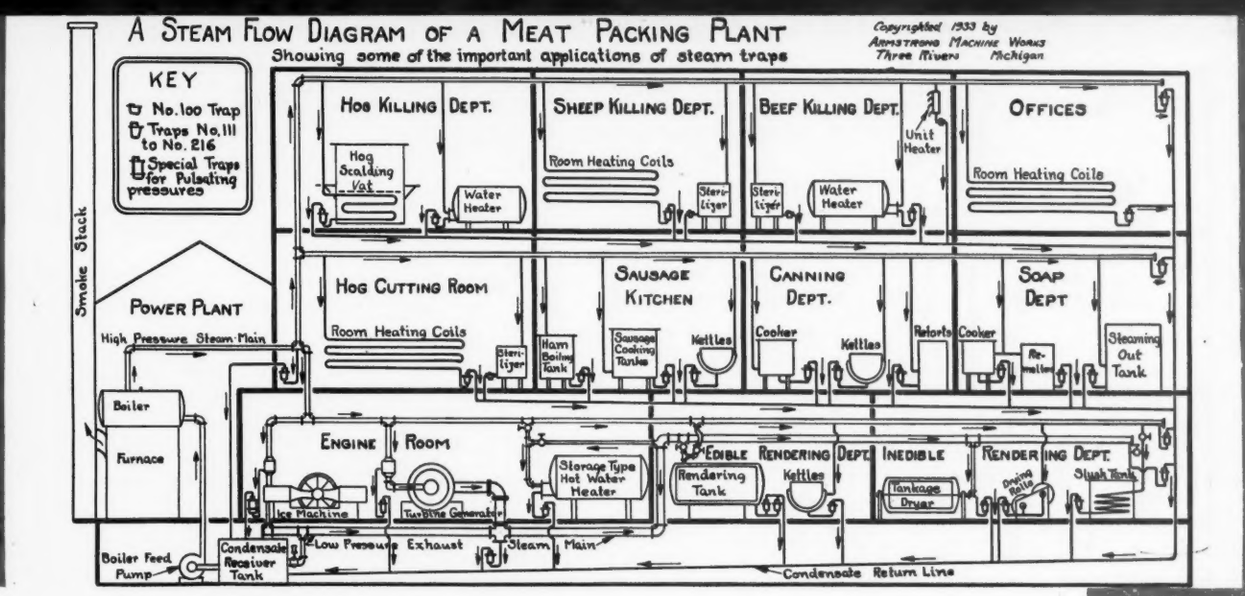


There is an Armstrong trap for every requirement in the use of steam for heating, power or processing. Let our nearest representative discuss your trap problem with you or write the Armstrong Machine Works, Three Rivers, Michigan, for a copy of the Armstrong Steam Trap Book.

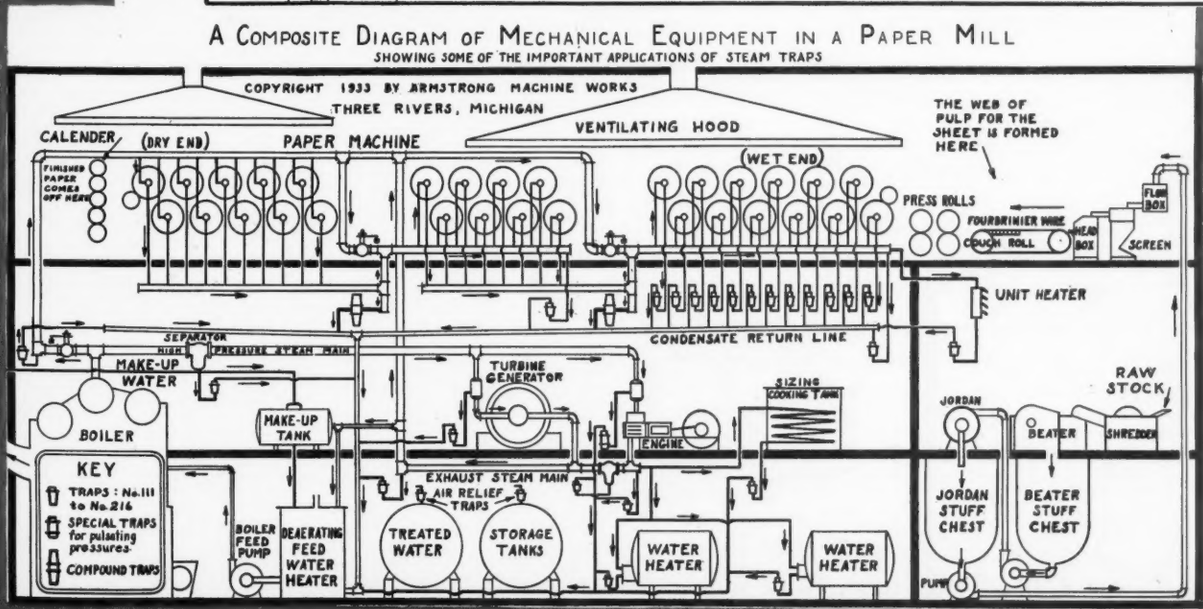


Steam Charts Show With Process Equipment

ARMSTRONG "INVERTED BUCKET" STEAM TRAP

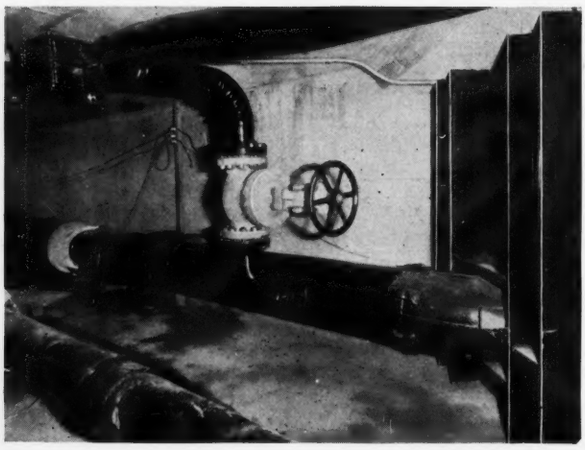


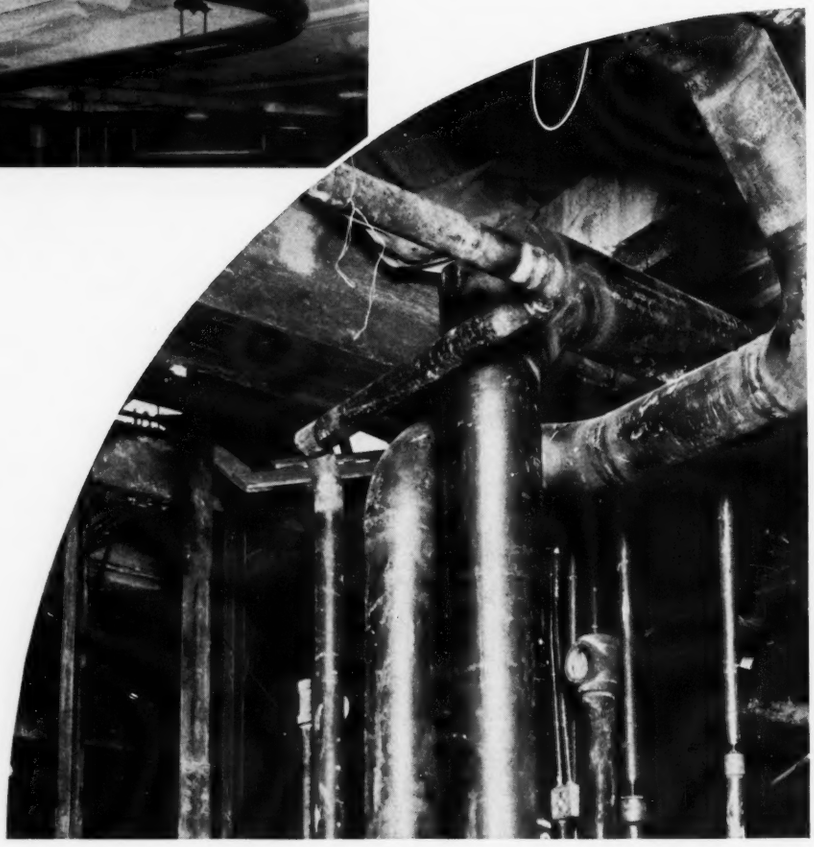
Machine Works and were published in the Armstrong Trap Magazine. Extra copies on request.



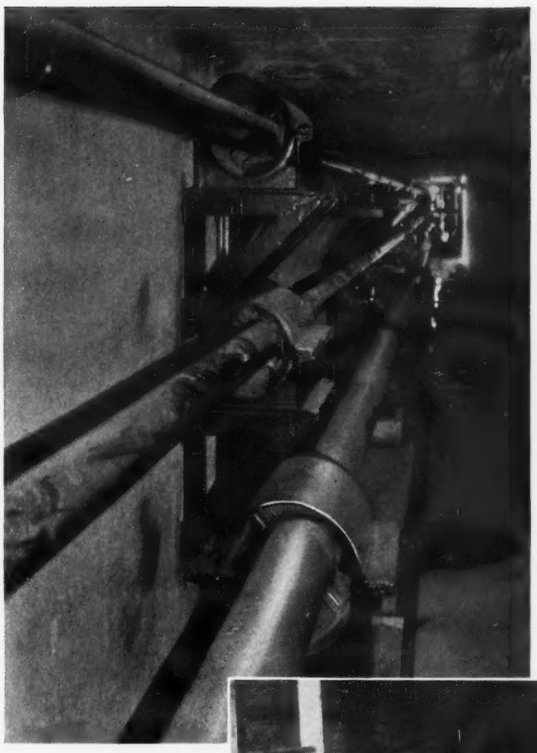
Just PIPING

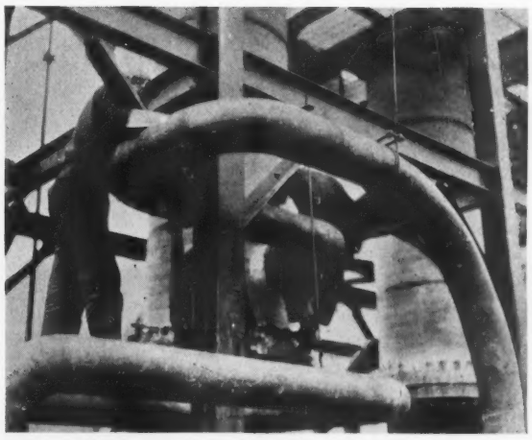
—BUT IT'S WELDED

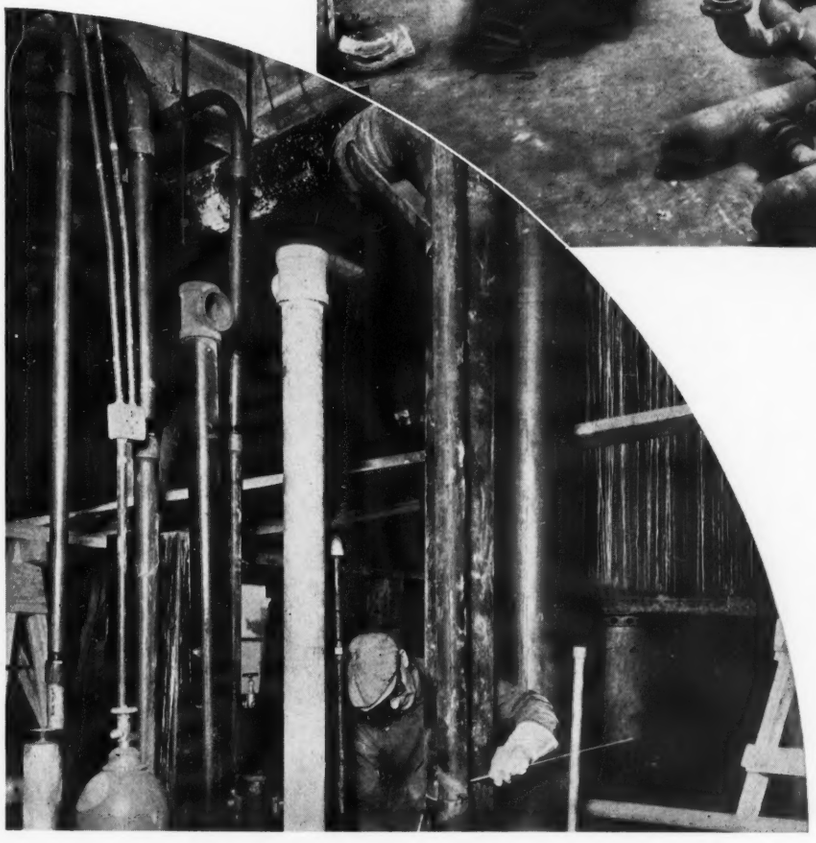




Power piping, in four cases welded by the arc, in four by oxy-acetylene. Upper left—Gas welder finishing a job using welding fittings to simplify erection and increase flow efficiency. Lower right on this page, lower left on facing page—Gas welding building steam piping, a job difficult to do by conventional methods. Two center photographs on each page—Some of the 42,800 ft. of new underground arc-welded 300-lb. steam lines supplying heat to Government buildings in Washington. Directly above is a 6-in. main in the Federal Warehouse, at upper right is the chamber at corner of Twelfth and C Sts., showing connection into the Warehouse conduit.







Upper left—Arc-welded 18-in. steam main and 10-in. return line anchorage in Twelfth St. tunnel, Washington. Center right—Arc-welded manifold assemblies for the Washington system. Steam mains vary from 18 to 4 in., condensate return and drip mains from 10 to 1¼ in. Included are 246 slip-type and packless expansion joints, numerous expansion loops, intricate pipe welding. The system cost more than $1,250,000. Upper right—Unusual turns in 500-lb. gas-welded piping at a large chemical plant.

Photographs courtesy Lincoln Electric Co. and Linde Air Products Co.

This Plant Engineer
he installed
TRADE MARK
Rx
REGISTERED
CONTINUOUS
CONTROLLED CIRCULATION

is sitting on top of the World
RILEY STEAM GENERATING UNITS

It is the duty of the plant engineer to see that steam is produced at his plant as economically as possible. If obsolete equipment makes this impossible, it is up to him to see that a study is made and presented to his executives showing savings which are possible through the installation of modern equipment and what it would cost to install this equipment. Consulting engineers, because of their wide experience in the preparation of such studies, can profitably be employed to co-operate with the plant engineer in the preparation and proper presentation of these figures.

The plant engineer who does this will be sitting on top of the world when actual savings meet or exceed his anticipated figures. The selection of Riley Steam Generating Units will assure such results with complete satisfaction. Plant after plant has selected Riley equipment because of the satisfactory performance of existing Riley installations. There is a very definite swing to Riley Units. Look over a few of these recent installations listed below.

Riley engineers will be only too glad to aid you and co-operate with you in getting together studies of savings which can be made at your plant through the installation of Riley Steam Generating Units. It is our business to so co-operate with you. Just write to the nearest Riley office and an engineer will gladly call and discuss this matter with you. Of course, there is no charge nor obligation for this service.

MAY WE SEND YOU

A Collection of ⅛″ Scale Drawings of some Recent Installations of Riley Units?

We will gladly send you drawings of many of the recent installations of Riley Units together with information about the performance of these units. These drawings will be a valuable addition to any plant engineer's library. Just write the Riley Stoker Corporation, Worcester, Mass.

A Few of the Recent Installations of Riley Steam Generating Units

W. Va. Pulp & Paper Co., Covington, Va.	375,000 lbs. of Steam per hour
W. Va. Pulp & Paper Co., Luke, Md.	375,000 " " " " "
A Large Eastern Oil Refinery	300,000 " " " " "
Kalamazoo Vegetable Parchment Co., Mich.	150,000 " " " " "
Forstmann Woolen Co., Passaic, N. J.	60,000 " " " " "
Forstmann Woolen Co., Garfield, N. J.	80,000 " " " " "
Pennsylvania Sugar Co., Phila., Pa.	300,000 " " " " "
Continental Distilling Co., Phila., Pa.	100,000 " " " " "
Jacob Dold Packing Co., Buffalo, N. Y.	67,000 " " " " "
General Aniline Co., Grasselli, N. J.	65,000 " " " " "
Hamilton Woolen Co., Southbridge, Mass.	70,000 " " " " "
Finch Pruyn Co., Glens Falls, N. Y.	50,000 " " " " "
Columbia University, New York City	100,000 " " " " "
American Oak Leather Co., Louisville, Ky.	34,500 " " " " "
Container Corp., Philadelphia, Pa.	200,000 " " " " "
Container Corp., Philadelphia, Pa.	55,000 " " " " "
Titanium Pigment Co., Sayreville, N. J.	125,000 " " " " "
Savannah Sugar Co., Savannah, Ga.	100,000 " " " " "
Beechnut Packing Co., Canajoharie, N. Y.	40,000 " " " " "
Crompton & Knowles Loom Works, Worcester, Mass.	40,000 " " " " "

RILEY STOKER CORPORATION
WORCESTER, MASS.

BOSTON NEW YORK PHILADELPHIA PITTSBURGH BUFFALO CLEVELAND DETROIT TACOMA ST. LOUIS CINCINNATI HOUSTON
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BOILERS • PULVERIZERS • BURNERS • STOKERS
SUPERHEATERS • AIR HEATERS • ECONOMIZERS
WATER-COOLED FURNACES • FLUE GAS SCRUBBERS
STEEL-CLAD INSULATED SETTINGS

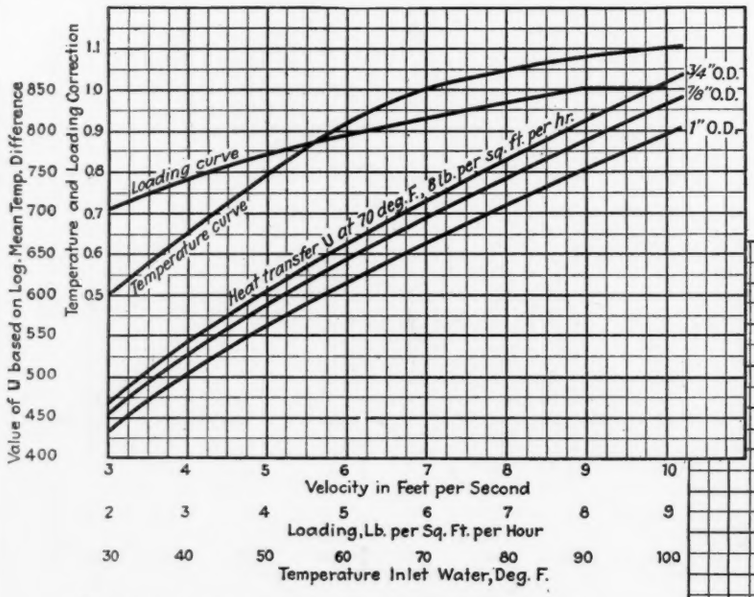
Number 26

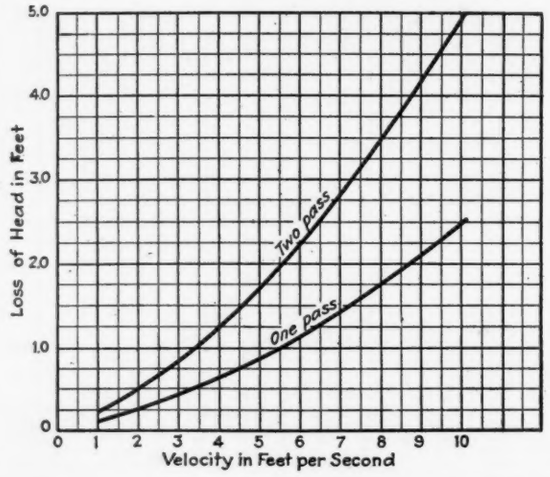
SURFACE CONDENSER DATA

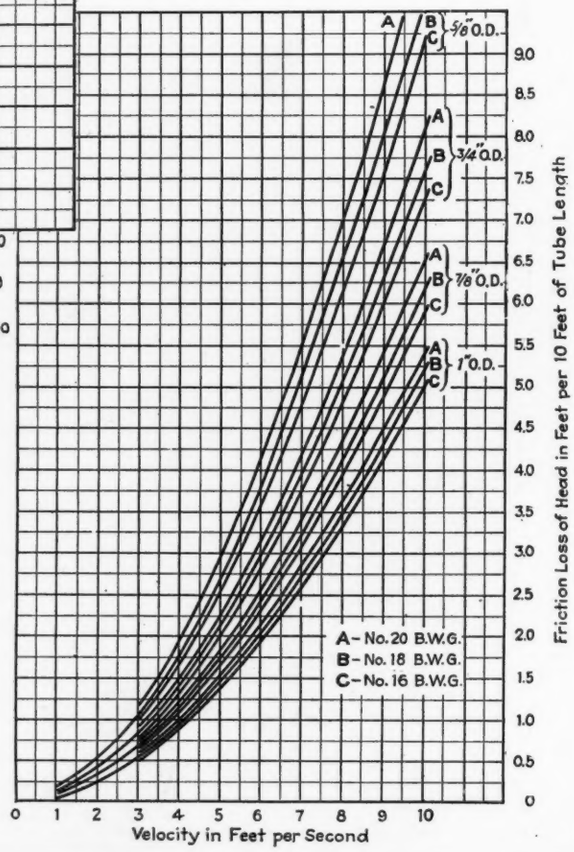
CONDENSER TUBE DATA

	Outside Dia. In.	1½		1		⅞		¾		⅝	
	B.W.G.	20	18	20	18	20	18	20	18	20	18
	Thickness, In.	0.035	0.049	0.035	0.049	0.035	0.049	0.035	0.049	0.035	0.049
Inside	Diameter, In.	1.18	1.152	0.930	0.902	0.805	0.777	0.680	0.652	0.555	0.527
Inside	Cross-sec. Area, Sq. In.	1.094	1.039	0.6793	0.6390	0.5090	0.4742	0.3632	0.3339	0.2419	0.2181
Inside	" " " Sq. Ft.	0.006331	0.006012	0.004717	0.004438	0.002945	0.002744	0.002522	0.002319	0.001680	0.001515
Inside	Vol. per Lin. Ft., Cu. Ft.	0.006331	0.006012	0.004717	0.004438	0.002945	0.002744	0.002522	0.002319	0.001680	0.001515
Inside	Water, Lb. per Lin. Ft. at 60°	0.3948	0.3749	0.2942	0.2768	0.1837	0.1711	0.1573	0.1446	0.1048	0.0945
Outside	Diameter, In.	1.25		1.00		0.875		0.75		0.625	
Outside	Circum., In.	3.927		3.1416		2.749		2.3562		1.9635	
Outside	Cross-sec. Area, Sq. In.	1.227		0.7854		0.6013		0.4418		0.3068	
Outside	" " " Sq. Ft.	0.007101		0.005454		0.003479		0.003068		0.002131	
Outside	Surface per Lin. Ft., Sq. In.	47.124		37.6991		32.988		28.2744		23.562	
Outside	" " " " Sq. Ft.	0.2727		0.2618		0.1909		0.1636		0.1363	
Outside	Lin Ft. per Sq. Ft. of Surface	3.667		3.8197		5.2383		6.112		7.336	
	Metal Area, Sq. In.	0.133	0.188	0.1061	0.1464	0.0923	0.1271	0.0786	0.1079	0.0649	0.0887
	" Vol., Cu.In. per Lin. Ft.	1.596	2.256	1.2732	1.7568	1.1076	1.5252	0.9434	1.2948	0.7788	1.0644
Copper	Density, Lb. per Cu. In.	0.323		0.323		0.323		0.323		0.323	
Copper	Lb. per Lin. Ft.	0.516	0.728	0.411	0.567	0.358	0.493	0.305	0.418	0.252	0.344
Copper	Lb. per Sq. Ft., Out. Area	1.892	2.669	1.571	2.167	1.875	2.582	1.552	2.130	1.537	2.100
Copper	Sq. Ft. per Lb.	0.528	0.3746	0.637	0.461	0.533	0.387	0.644	0.469	0.650	0.476
Brass (70-30)	Density, Lb. per Cu. In.	0.305		0.305		0.305		0.305		0.305	
Brass (70-30)	Lb. per Lin. Ft.	0.487	0.688	0.388	0.535	0.338	0.465	0.287	0.395	0.238	0.324
Brass (70-30)	Lb. per Sq. Ft. Out. Area	1.785	2.506	1.483	2.045	1.771	2.435	1.464	2.011	1.452	1.981
Brass (70-30)	Sq. Ft. per Lb.	.560	.399	0.674	0.489	0.565	0.411	0.683	0.497	0.689	0.505

OWNERS and prospective purchasers of condensers, as well as designers, periodically wish to determine characteristics. This table and three charts, the latter giving commercial factors for designing surface condensers approved by six leading condenser builders, will supply a basis for calculations. The chart at left gives commercial heat transfer curves for designing condensers for use with turbines. The chart at lower left gives curves for determining water-box losses in condensers, and that below gives curves for determining friction of water in condenser tubes.

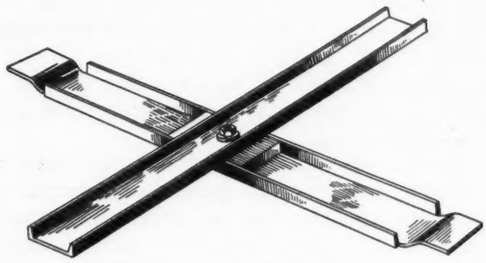

Value of U based on Log. Mean Temp. Difference
Temperature and Loading Correction
Loading curve
Temperature curve
Heat transfer U at 70 deg. F., 8 lb. per sq. ft. per hr.
¾" O.D.
⅞" O.D.
1" O.D.
Velocity in Feet per Second
Loading, Lb. per Sq. Ft. per Hour
Temperature Inlet Water, Deg. F.





© POWER

PRACTICAL AIDS TO OPERATION



Portable Staging for Vertical Fire-Tube Boiler Furnace

MODERN vertical fire-tube boilers have considerably higher furnaces than many earlier installations, usually too high to permit convenient work on upper parts without some form of staging. In many plants this staging consists of a plank laid across the top of the brickwork above the mud-ring. This is rather unhandy as it must be moved often and it is also likely to tip and cause the workman to have a bad fall.

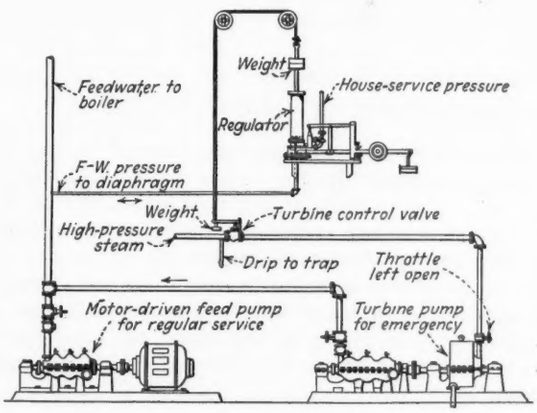
The diagram shows a staging easily constructed from two pieces of lightest-weight channel iron and a wood block. These channels are about 6 in. longer than the internal furnace diameter and are about 12x3x¼ in. The sides of one channel are cut off at each end with a hack-saw or torch to at least 9 in. from the end. The bottom sections are then heated with a torch and bent to bring them on a level with the bottom of the top channel. The channels and block are assembled as in the figure.

This channel-iron staging may be folded together to be handed through the furnace door, then opened up inside as in the diagram. The ends fit on top of the brick work at the lower part of the furnace and a workman can reach all upper parts of the furnace from this staging with little danger of slipping.

Boston, Mass. HARRY M. SPRING

Hydrostatic-Regulator Control For Feed-water System

THERE are many practical applications of the conventional hydrostatic damper regulator in the boiler room.



Among these is an interesting plan worked out in a high-pressure plant. Feed water was supplied to the boilers of this plant by a motor driven centrifugal pump. A steam-turbine driven pump was also installed for stand-by and emergency service. With the small water-storage capacity of modern, high-pressure boilers it is imperative that, at full load, interruption of feed water flow be for not more than a fraction of a minute. It is also important with high-temperature, high-pressure feed water piping that should there be a loss of pressure, the pressure be built up again slowly to prevent water hammer.

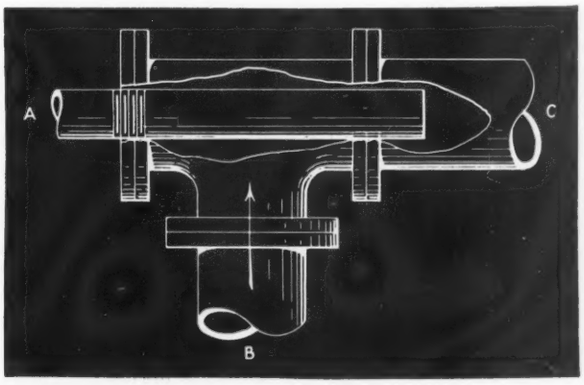
The diagram shows piping details for the hydraulic regulator. If the feed-pump trips off for any cause, a pressure drop in the feed-water header causes the hydraulic regulator to function and brings the turbine-driven pump up to speed. This regulator is adjusted to prevent more than a 25 per cent drop in pressure in the feed-water header. The weights on the regulator are carefully adjusted to prevent any hunting action in the operation.

Cleveland, O. C. O. PERKINS

Pump Suction Used as Condenser

WHEN steam is not required for process, and an ample supply of water is available, it usually pays to operate condensing. Yet, when two nearly similar plants changed to condensing operation, the results were so different that one engineer received honorable mention and the other lost his job.

On a certain railroad, pumping stations were neces-



sary to supply the locomotives, and these stations were sometimes a considerable distance from the tracks, necessitating a long pipe line. At one of these stations, where the suction lift was 24 ft. and discharge head 80 lb., the pump man made a novel suction fitting into which he ran the exhaust from the engine driving the pump. This acted as a condenser, creating an exhaust vacuum of 20 in. Hg, and made a material saving in fuel.

The exhaust fitting is shown in the illustration. It is important to have the exhaust steam enter at *A* and the water at *B*. If the water enters on the run and the exhaust steam enters on the branch, water hammer will probably result.

At the railroad plant there was no feed-water heater on the exhaust line, the ratio of the steam to water cylin-

ders was high, it being a 14x9x14 pumping engine, and the suction lift was high. It costs the railroad man not a penny to get 20 in. of vacuum.

An engineer of a large truck farm accidentally ran across this railroad pumping station, and was so impressed with the idea that he straightway went home to apply the scheme to his own pumping outfit. The railroad pumpman told the truck-gardener engineer that the arrangement showed a saving of approximately 20 per cent.

The latter worked like a Trojan to pry the necessary money from Old Mac, the owner, then to get the fittings together to turn the engine exhaust into the suction fitting. But he rushed into the change without giving it proper analysis, for after he had completed the work the pump did not respond as he had anticipated. The pump did not speed up when he changed the exhaust, as the railroad pump had done.

His boss called in an engineer of ability who, at first glance, observed: "You never will get any vacuum, to speak of, until you place a valve in the suction line. You see, the lift is only about 4 ft."

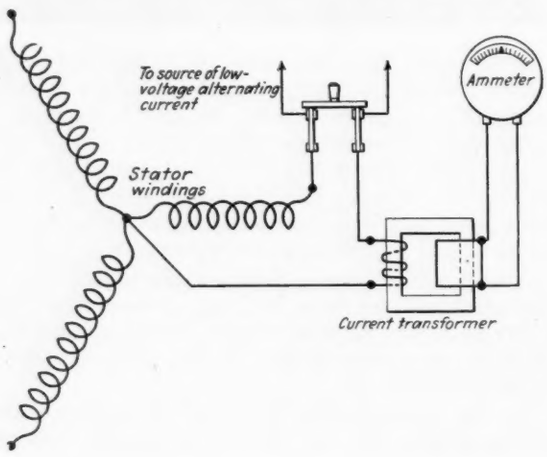
But the owner would not buy an expensive valve for the suction line, and so an orifice was cut out of sheet metal and inserted in suction pipe ahead of the exhaust connection. Also, a vacuum gage was obtained. The orifice boosted the vacuum to about 18 in. Hg, and the throttle had to be opened further than ever. The vacuum was proving a decided holdback. Another expert was called in. Mr. Mac was getting peeved.

The new engineer observed that for each inch of vacuum secured for the engine it placed an additional suction lift on the pump consequently increased the power required to drive the pump.

Lawrence, Mass. C. W. PETERS

Testing for a Reverse Coil in a Stator Winding

A METHOD that I have used to locate reverse coils in a stator winding of a three-phase motor may be of interest to *Power* readers. I have a portable ammeter with a split-core type current transformer. If the conductor in which the current is to be measured is wrapped several times around the transformer core, a small current flowing in the conductor can be made to give a large reading on the meter. I have taken advantage of this to test for reverse coils in induction motor windings.

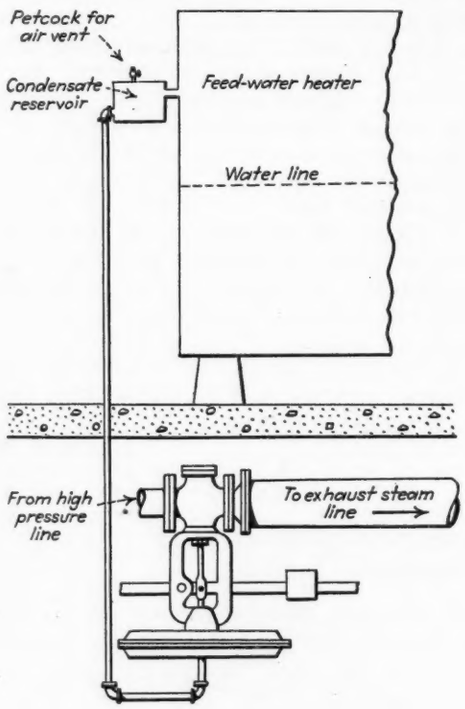


The transformer is connected to one phase winding of the motor and to a source of low-voltage alternating-current, as in the figure. A reading is taken on this winding, then the switch is opened and the power lead moved to another terminal of the winding and a reading taken on another phase. If the phase windings are alike, then the ammeter should read the same on all of them. If a coil is reversed in one winding, then the reading on this winding will be high. By breaking up the high-reading phase into pole groups and testing each group separately I can locate the group having the reversed coil by a high reading.

In a 15-hp., 440-volt motor I found that when a pole-phase group of four coils properly connected gave a meter reading of 100, one coil reversed increased the reading to 150. I have tried other methods, but none has been as satisfactory as the one described.

A short-circuited coil in a group will produce the same effect on the meter, but this coil heats more than others when the winding is connected to a source of power. When a coil is reversed in a winding, all coils will heat alike. It should also be kept in mind that in some windings the coil groups do not all have the same number of coils, and this must be taken into consideration when making the test.

Lomita, Calif. C. H. FENTON



Condensation Reservoir Improves Reducing Valve Operation

CONSIDERABLE difficulty was experienced in maintaining constant pressure in the steam space of a deaerating heater. Plant conditions required a pressure of 2 lb. in the heater to insure proper deaeration. Due to deficiency in the exhaust steam available for use in the heater, a reducing valve was installed to supply the additional steam required from a higher-pressure source. It was necessary because of piping arrangements to install this valve in the basement below the floor on which the heater is located.

Upon putting the heater in service, fluctuations of pressure were encountered which seriously interfered with proper functioning of the equipment. Investigation disclosed the trouble to be a variation of the static head of water in the small vertical pressure line between the heater steam space and the reducing valve diaphragm, caused by the pumping action of the diaphragm as the reducing valve opened and closed to meet sudden load fluctuations. This trouble was eliminated by installing a condensation reservoir made up of a 4-in. diameter pipe nipple and eccentric fittings in the pressure line adjacent to the heater. The water storage in this reservoir is sufficient to compensate for the variation in the water content of the diaphragm chamber, insures a constant static head, and eliminates practically all trouble from pressure fluctuations.

Waynesboro, Va. S. H. COLEMAN

Furnace Temperature Damages Boiler Supporting Columns

RECENTLY, when inspecting a battery of three horizontal boilers, I noticed that the feedwater line to them was out of what would be considered normal position. When

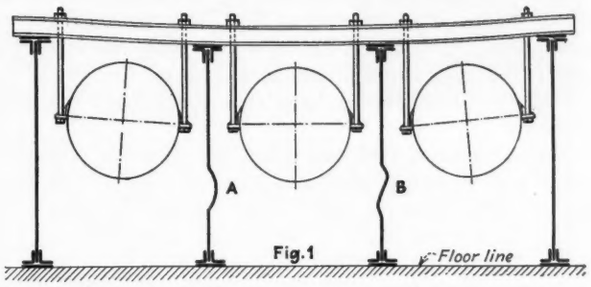


Fig.1

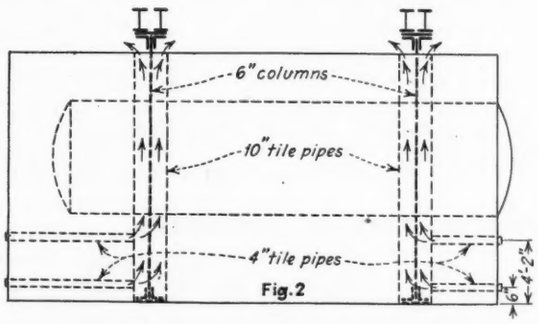


Fig.2

checking up on the boilers it was found that the center boiler was 1.5 in. lower than the outside ones and these had turned in their settings, as in Fig. 1. The boilers were taken out of service and an examination of the settings revealed that the steel supporting columns were sprung as at *A* and *B*, Fig. 1.

These boilers were originally set for hand firing and later equipped with mechanical stokers. The increase in furnace temperature when using the stokers was sufficient to overheat the supporting column until the weight of the boilers caused them to bend.

To correct the trouble, the boilers were emptied and lifted to their proper position by hydraulic jacks, then timbered in this location. The jacks and damaged columns were then removed and new columns installed inside of 10-in. tile pipe, as in Fig. 2. To keep the columns cool, the bottom and third-from-bottom sections of the tile pipes were selected with a 4-in. tee. From these, 4-in. branches were extended outside the brick work. When the masonry was put back into place, the tops of the tile pipes were left open so that there was a free circulation of air through them, as indicated in Fig. 2, to keep the columns from overheating.

A hydraulic test showed the boilers to be in good condition. It has been several months since the boilers were put back into service, and no movement has been observed in their supports, but a flow of warm air comes from the tops of the tile pipes.

Fall River, Mass. B. BOVENZI

Capacitor Installation Pays for Itself in Eleven Months

AT THE plant of the United Steel & Wire Co., Battle Creek, Mich., power bills savings in eleven months more than paid for a capacitor and its installation cost totalling $931. A small rack-type 80-kva. capacitor placed in an out-of-the-way place, was used. Power bill data furnished by the power company indicated a monthly demand ranging from 116 to 140 kva. The yearly net bill before the installation totalled $8,766, while the actual yearly bill after the capacitor was installed amounted to $7,693, a saving of $1,073, or an average of about $89.50 a month.

Schenectady, N. Y. F. A. STORTZ, JR., *General Electric Co.*

A Simple Universal Joint

ON MANY occasions in plant operation I have found it necessary to open and close valves or engage a clutch by remote control. The universal joint in the diagrams will transmit the movement to open or close a valve or produce other mechanical actions. To make the joint, thread four studs into a metal square, Fig. 1. Split down two

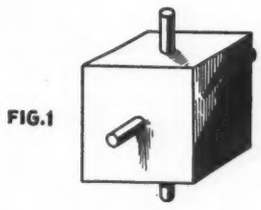


FIG.1

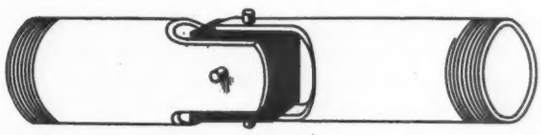


FIG.2

pipe nipples with the hacksaw, heat their ends and forge out to shape, Fig. 2. Drill and close down the pipe ends to fit over the studs in the block. The joint can then be assembled and it may be connected by sleeve or union into the operating mechanism. A series of these universal joints may be used to turn bends and corners through walls or other objects that may be in the way.

Vancouver, B. C. S. H. COOKE

CURRENT COMMENT

Power Gas Producers, If Not Dead, Are Certainly Dormant in America

THE power gas producer (August, 1934, *Power*) has so quietly faded from the picture that engineers have scarcely been aware of its passing. I cannot recall having seen or heard of, in the past ten or fifteen years, a power gas producer in operation in this section of the country, where twenty years ago there were a considerable number, mostly of small size, in more or less continuous and successful use.

The early history of gas producers in this country was none too rosy, and an unwarranted prejudice resulting from operating difficulties with primitive equipment may be partially responsible for their demise. Among one certain group of budding young engineers at a middle western college, conducting experiments with a producer twenty odd years ago, a spectacular explosion did much to dampen enthusiasm. Fortunately, no casualties resulted, but the apparent violence and destructiveness of the catastrophe was highly impressive.

But while gas producers have fallen by the wayside in this country, it is interesting to learn that research and development have continued in Europe, and it is even more interesting to learn that many of the difficulties encountered years ago have been overcome. These, more than anything else, discouraged use of the power gas producer; a close second was the availability of cheap fuels, coal, oil or gas, in most parts of this country.

Admitting the high over-all thermal efficiency and low fuel costs possible with the power gas producer under favorable conditions, and that many of the early operating difficulties experienced with producers and their accompanying gas-purifying auxiliaries have been overcome, there are still reasons why it is improbable the gas producer and engine will soon be a serious competitor of the natural gas engine, the diesel engine, the steam engine or turbine in this country.

One of the principal reasons is the inherent lack of flexibility of the producer, its inability to respond quickly to large and sudden fluctuations in demand for gas, unless assisted by large-capacity gas storage. Even with the crude equipment of twenty years ago, this characteristic often proved a greater handicap than the problem of gas purification. In fact, with anthracite, the fuel generally used in early-day producers, purification of the gas was not so difficult or troublesome; it was when attempting to use bituminous, lignite, etc., that real grief was encountered. Then, too, sudden changes in demand for gas caused serious variations in the quality of the gas generated in the producer with consequent irregular operation of the engine. Unless these difficulties have been overcome, the power gas producer is limited to a field of application where power requirements are reasonably uniform for long periods.

The heat content of producer gas is low. With the producers of two decades ago, a heat content below 130 B.t.u. per cu. ft. was more common than a heat content above. Probably under the most favorable conditions a heat content of from 145 to 150 B.t.u. per cu. ft. is the upper practical limit. Because of this, the producer gas engine is a somewhat larger and more costly machine than the natural gas engine of equivalent capacity.

Using data from Mr. Lustig's article in the August, 1934, *Power;* from 14,000 B.t.u. lb. coal costing $3.85 per ton, 1,000,000 B.t.u. in cooled purified producer gas could be obtained at the following approximate fuel cost:

14,000 B.t.u./lb. coal $\times$ 2,000 lb./ton = 28,000,000 potential B.t.u./ton at $3.85. Hence a potential of 1,000,000 B.t.u. in the fuel would cost $3.85 $\div$ 28 = $0.1375. Now with a producer of 80 per cent efficiency from solid fuel to cool purified gas, the fuel cost of the producer gas per 1,000,000 B.t.u. would be $0.1375 $\div$ 0.8 = $0.17187. I am unable to reconcile these figures, which I believe are substantially correct, with Mr. Lustig's figures in "Table II—Actual Cost of 10,000 B.t.u. effective from various sources," stating the actual cost for producer gas as $0.0029. However, the difference in our figures, about 18 per cent, is not enough to quarrel about.

In recent years there has been a widespread distribution of natural gas. The approximate average heat content of this natural gas is 1,000 B.t.u./cu. ft., and over large areas this fuel is available for industrial purposes to quantity users at prices ranging from $0.10 to $0.25 per 1,000 cu. ft. At a price of $0.17187 per 1,000 cu. ft., this natural gas would be on a par with producer gas generated under conditions specified in the preceding paragraph in so far as bare fuel costs alone are concerned.

But, of course, fuel cost is but one of many costs that enter into power production, and the higher first cost, higher fixed charges and higher operating costs (for items other than fuel) of power gas producers tend to offset their high thermal efficiency and limit them to localities where fuel costs are comparatively high. There may be occasional conditions where power gas producers would be economically sound. I, and no doubt many other American engineers, would welcome additional information on what European manufacturers and engineers have accomplished during the 20-year gas producer hibernation period in this country.

Oklahoma City, Okla. J. H. BENDER

High-Speed Vs. Low-Speed Diesels

J. H. BENDER'S objections (*Power*, August, 1934) to Mr. Shaefer's proposal (*Power*, May, 1934) of a battery of high-speed diesels in a plant interest me. The statements which I am about to make are based on a very careful study of many American and European diesel engines, analyzing them from both the thermodynamic and mechanical standpoints.

I would like to remind Mr. Bender that a plant such as that outlined by Mr. Schaefer already exists in the German "vest-pocket" battleship *Deutschland*. This ship today represents the last word in economical ship propulsion, showing maximum efficiency at all speeds.

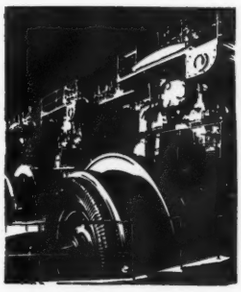
Now, relative to first cost: the first cost of a 100 hp., 1,800-r.p.m. high-speed diesel, manufactured on a production basis by a high-grade firm, should be approximately $20 per hp., certainly not more than $25.

Mr. Bender is skeptical of the high rotative speeds proposed, with the corresponding high piston speed. In my experience, 1,800 ft. per min. is not excessively high. High-speed diesel engines of 120 hp. are being turned up

to 3,500 r.p.m., piston speed 3,000 ft. per min., by several European manufacturers. These units are doing a very good job in marine, truck, and bus service, as well as operating isolated electric plants.

Mr. Bender draws a comparison between diesel engines operating at 1,800 ft. per min. piston speed and a modern airplane engine. In the first place, the figures quoted on airplane work by Mr. Bender are entirely too low. The British Royal Air Force regularly runs its water-cooled engines 450 to 500 hr. between overhauls, while the nominal life of these same engines exceeds 10,000 hr. It is indeed difficult to set up the correct nominal life, inasmuch as a large number of such engines have been in service more than ten years, not only in Army and Navy planes, but also in commercial machines.

Mr. Bender admits that there can be no comparison between a high-speed stationary diesel of reasonable weight and the light-weight airplane motor. As a matter of fact there is *no* comparison, which the following figures show. The water-cooled airplane motor as mentioned above delivers without supercharging 0.4 b.hp. per cu. in. of cylinder displacement, while the over-all efficiency of this type of engine ranges from 26 to 29 per cent. Therefore, using the lower figure, we have for an output of 0.4 hp. per cu. in. a power loss of 1.14 hp. per cu. in., while in the high-speed diesel, the horsepower per cubic inch will be approximately 0.2 with an over-all efficiency minimum of 35 per cent. Therefore, the power loss in the case of the diesel is 0.37 hp. per cu. in.



All things being equal, the destructive effect taking place within an internal combustion engine is measured by the lost energy. Then we have the item of weight already mentioned, which is ten to one in favor of the diesel.

Mr. Bender is also skeptical of the figures given by Mr. Schaefer regarding the length of time necessary between overhauls. From my own investigations, I am willing to admit that the figures given by Mr. Schaefer are more than can be expected of the rank and file of American engines. The reason for this is more thermodynamic design than mechanical design. However, in my experience, I can cite several European high-speed diesels which will better Mr. Schaefer's figures by 25 per cent.

The figure of 0.45 lb. of fuel oil per b. hp.-hr. has become the accepted value for American high-speed diesels. In my experience there are many high-grade high-speed diesels operating on 0.35 lb. of fuel oil per b. hp.-hr., while by far the greatest percentage of engines with which I have had any connection operate at below 0.40 lb. of fuel oil per b. hp.-hr. The values mentioned above have reference to engines functioning perfectly in every respect.

Relative to the operation of small units on heavy fuel, I would like to point out that the type of fuel on which an engine operates is purely a matter of fuel pump and injection nozzle design. Small high-speed diesels have been, and are today operating on a mixture of powdered coal with just sufficient oil to allow this powdered coal to be carried along the fuel lines. Therefore, Mr. Bender's remarks on the difference of the cost of fuel oil do not carry much weight.

The same is true of lubricating oil. Lubricating oil consumed by any modern engine is usually a factor of brake horsepower.

Generally speaking, the cost of renewal of worn parts is directly proportional to the material worn away. This is irrespective of the size or speed of engine. Given equal lubrication and equal surface hardness, the rate of wear in terms of pounds per hour will be about the same for either low- or high-speed engines but, of course, the high-speed engine cannot on account of its smaller size sustain so large a loss of weight by wear as the larger slow-speed type. Consequently, renewals are more frequent but correspondingly less expensive. Moreover, owing to the small size and ease of handling parts, renewals are made in much shorter time. Over a given period of years, it will be found that the total cost of renewals and total loss of time through overhauling will be about the same for both high- and low-speed engines.

We must bear in mind, however, (a) the high-speed engine being smaller, the parts are usually of such design that they can be and are made from very much better materials, providing harder wearing surfaces, (b) the engine being smaller, unit construction can be used, making a much stiffer job, hence machining and maintaining the alignment of bearings is much simpler, (c) high-speed engines are generally better lubricated due to the compactness of the engine form. Against this are these disadvantages of the high-speed engine: (a) maximum pressures in the cylinder are somewhat higher; (b) the average load factor on high-speed engine bearings is usually somewhat greater due to the difficulty of providing the necessary space for these bearings.

In all internal combustion engines, wear must be considered in the following parts: (a) crankshaft, (b) cylinder liners, (c) piston rings and ring grooves in the piston, (d) various pin joints and their bushings. In the small high-speed engine it is posisble to use either heat-treated alloy steel crankshafts, or built-up case-hardened crankshafts, which provide greatest wear resistance.

In the small high-speed engine, the cylinder liners can be made of much harder materials. Further, if the liners are of cast iron, they can be proportionately thinner, giving a correspondingly harder material and cooler operation.

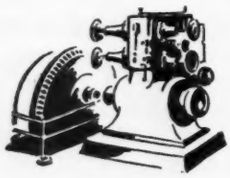
The life of piston rings and ring grooves is much the same, and the total cost of renewals over a period of years should be about equal for either type. Pin joints and bushings in the high-speed engine are usually designed, due to the small size, to be non-adjustable, as in the automobile engine. It is cheaper to fit a new pin or bushing than to attempt to make adjustments.

As against these mentioned advantages of the high-speed engine, it will be readily apparent that it is impossible to provide the same quality of materials in the large slow-speed machines due to the greater difficulty of manufacture. This is particularly true, for instance, of the crankshaft. The weight and dimensions are such that one is almost forced to use low-carbon steel with its poor wearing qualities.

At the present time I do not wish to enter into the pros and cons of Mr. Schaefer's proposal. I hope, however, that I have overcome some of Mr. Bender's skepticism regarding the high-speed engine.

Sandwich, Ont. BOYD CANDLISH, *F.R.S.A.*
Consulting Engineer

READERS' PROBLEMS



QUESTIONS for Our Readers

What Causes Knock in Compressor

Question 1

WE HAVE *two compressors, a 45-ton and a 60-ton, which heretofore operated at head pressures of 125 to 150 lb. Now, due to the cutting in of lines and the adding of new coils that have increased refrigerating surfaces about 40 per cent, they operate at head pressures of between 175 and 225 lb. Excess air in the system cannot be purged out every day because the lines have to be opened in the morning and put back into operation in the afternoon for production.*

Up to the time of the recent change the compressors ran very smoothly, but since the change was made they have developed a decided knock, which has all the indications of that caused by a wet gas when it is coming back and freezing over. However, there is no visible evidence that it is coming back. The compressors do not frost over. The suction pressure is quite normal, 22 to 25 lb.

My first thought was that the compressors were laboring due to overload caused by the added amount of refrigeration they now have to carry. However, cutting out these new additions by closing the expansion valves and putting on only those which have not been changed so far (insofar as capacity is concerned) does not alleviate the trouble. The knock does not seem to be a mechanical defect because the compressor will run, continuously knocking, for ten or fifteen minutes, and then suddenly stop knocking and run just as smoothly as before for a few minutes, and then again begin to knock. This leads me to believe that somehow the wet liquid is slugging back. It has been suggested that to remedy this condition (due to the increase in refrigerating surface) the suction lines will have to be increased. Will you tell me what might be the cause of the trouble and how it can be corrected?

—M. S.

What About Condenser Tube Scale?

Question 2

WE ARE *making a study of scale deposits in the tubes of surface condensers. The question has arisen as to whether or not serious trouble with scale has been encountered where an adequate supply of fresh water (river, lake or well) is available, so that recirculation is not necessary. Water passes once through the condenser and is allowed to go back to the river, and sufficient water is available so that its temperature does not rise more than 10 deg. F. between the inlet and outlet of the condenser.*

I have had considerable experience in the operation of plants using unrecirculated condenser waters from various sources with varying degrees of hardness. I have experienced little difficulty with scale deposits such as is experienced when the water is cooled and recirculated, allowing the natural hardness in the water to concentrate in the spray pond or cooling tower. Experience of readers with this problem would be interesting. If heavy scale deposits have been encountered other than deposits of mud or silt where a continuous supply of fresh water is available, it would be of interest to know what the analysis of the water showed. To satisfy the conditions in mind, the water supply should be sufficient so that there is not an excessive rise in the temperature while passing through the tubes. —N. A. M.

Suitable answers to these questions from readers will be paid for if space is available for their publication.

Rotor Bar Comes Loose from End Rings

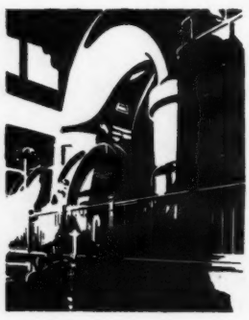
A SQUIRREL-CAGE *induction motor has two windings on the rotor, one for starting and one for running. The bars in the starting winding gradually break loose from the end rings. What effect does this have on motor starting characteristics?* P. P. P.

Loose bars in the starting winding will reduce the starting torque. If good connections cannot be maintained between the bars and end-rings by the method now used, then weld the bars to the rings. This is common practice.

Seger Pyrometer Cones

WHAT *are Seger cones and how are they used?* G. B. S.

These cones were developed in Germany by Dr. Herman A. Seger, in 1886, and comprise a series of triangular pyramids 50 mm. (1.97 in.) high, having a base 15 mm. (0.59 in.) on all three sides. They are used to measure temperatures in kilns and furnaces where pyrometers cannot be conveniently used and are made of several oxides mixed in proportions to give the cones different definite melting points. The temperature at which a pyramid bends over so that its apex touches the supporting surface determines a point on the Seger scale. The cones are carefully graded and a temperature corresponding to the cone number can be determined to within about 20 deg. F. of actual value, under favorable conditions.



The accuracy of the cones as an indication of temperature or the melting point of a refractory will depend somewhat upon the condition under which the tests are made. For example, where the temperature of the furnace is raised slowly the cones will become plastic at a considerably lower temperature than when the temperature increases rapidly. The composition of the combustible producing the heat also has a marked influence. For example a refractory brick that shows up good under a Seger test may fail at a comparatively lower temperature when used in a furnace, because of the sulphur and other elements in the fuel.

Besides the Seger series of cones, others have been devised for specific purposes. Dealers in chemical supplies can furnish standard Seger cones with melting points of from 1,000 deg. F. up to about 3,500 deg. F. advancing in steps of about 20 deg. F.

Is This Voltage Regulation Satisfactory?

A UTILITY *company is supposed to supply power at 460 volts alternating current to a 40-hp. motor. A test was made which showed 469 volts at the service switch at no load and 432 volts when the motor input was 30 hp. Would this be considered satisfactory voltage regulation?* P. P. P.

The answer to this question will depend upon several factors. At no load the voltage is 9 volts above, and at 75 per cent load it is 28 volts below, normal. This is a considerable change in voltage, but is not necessarily excessive. On a drive where close speed regulation is not a factor, this range in voltage might not be objectionable. Normally, 37 volts change from no load to 75 per cent would not be considered satisfactory voltage regulation. If the motor were installed on the end of a long line, this would have to be taken into consideration, and under these conditions the voltage regulation might be acceptable.

Aside from reduction in normal speed or in torque at starting, the motor should operate satisfactorily. Induction motors are designed to operate satisfactorily on a voltage 10 per cent above or below rated value, provided the frequency remains normal. Since the maximum variation in voltage at the service switch is only about 7 per cent below and about 2 per cent above rated voltage of the motor, a properly designed motor should operate satisfactorily on the line.

POOR CONTACT MOST LIKELY CAUSE OF OVERHEATED FUSES

ANSWERS to September Question No. 1

THE QUESTION

ON OUR *switchboard the studs of 600-amp. renewable fuses in some of the three-phase circuits heat excessively. On three occasions fuses have blown from this cause. The studs have been carefully aligned with the fuse terminals, but this did not correct the trouble even when clamps were used to hold the clips tightly to the fuse terminals. The maximum load on any of the fuses is about 400 amp. and the voltage between phases is 220. Can some reader of* POWER *give me some help with this problem?*

—J. H. P.

Fault May Not Be at the Fuse

J.H.P. will probably find that there is a corroded connection somewhere in the circuit. Connections should be taken apart

and cleaned. I have found connections where a fuse stud was almost corroded through, yet it did not show outside. This caused excessive heating and open fuses. The fault may not be at the fuse but some distance away in the circuit. I have seen a poor connection in a pull box cause trouble at a starter several feet away.

Indianapolis, Ind. M. V. MILLER

Five Causes of Trouble

HEATING of fuse clips and studs may be caused by improper alignment of parts, low contact pressure, contacts too small, dirt or oxide in contacts, poor contact between fuse links and terminals. Where heavy currents are involved, a small increase in contact resistance may cause a considerable increase in contact temperature. The voltage drop should be taken across the contacts with a millivoltmeter. A 10-millivolt drop through a connection will cause serious heating.

Fuse clips should be checked for alignment and for fit with the fuse terminals. This may be done with a 0.001-in. feeler gage at all points between the clips and terminals.

Heating anneals the fuse clips, and they cannot be made to contact the fuse terminals properly; therefore they should be renewed. If clamps are used to increase contact pressure to stop heating, contact surfaces between fuse terminals and clips should first be thoroughly cleaned.

I would suggest that all contacts in the fuses and on the clips and studs be opened and thoroughly cleaned with No. 00 sand paper and polished with crocus cloth. If any parts are found burned or pitted they should be replaced. If heating still persists, check the cross-sectional area of the contacts and studs to see if they meet code requirements.

Waynesboro, Va. J. M. MYERS

Lacquer Caused Poor Contact

OVERHEATING of fuses complained of by J.H.P. recalls an experience where fuses of double the required capacity failed under normal load. This trouble was corrected by cleaning the fuse contacts, which for some reason had been given a coating of lacquer. Any condition that will prevent the fuse clips and terminals on any of the connections from making good contact will produce unnecessary heating and may cause the fuse to fail when only partly loaded.

Chester, Pa. FRANK W. MCLEAN

How to Test for Fault

J.H.P.'s trouble is undoubtedly due to poor contact somewhere in the fuse-mounting assembly. There will be a definite contact drop at the source of the trouble, which can be located with a millivoltmeter. Test across from the fuse ferrule to the fuse jaw, from the jaw to the stud, and from the stud to the bus bar.

It is also possible that the fault is between the refill link and its clamping plate, but 90 per cent of such troubles are between the fuse blade and the holding jaws. Serious heating here oxidizes the copper, and no amount of aligning or clamping will reestablish contact. I have found it frequently necessary to install new jaws, as rectifying the trouble is difficult otherwise, especially if the heat has taken the spring out of the copper.

Parallel, bright copper surfaces are necessary inside the fuse jaws, and the fuse blade must be clean. Sometimes it is necessary to use grinding compound and grind in with a piece of flat metal of the correct thickness to fill the jaw space. Usually a hardwood stick, covered with emery cloth and of correct thickness to keep the emery pressing against the jaw sides, can be used successfully as a file. Coarse emery should be used first to cut the oxide, followed by fine emery cloth to give the desired polished surface.

Toronto, Ont. L. A. HUNT

Recommends Cleaning Connections

A good cleaning job on the fuse terminals and clips will probably remove the trouble. Clean the contact and bolt connections, with fine emery cloth, until they shine. Remove nuts from the studs and check the connections between the cables and lugs by twisting them slightly. Note if the strands are held firmly in the lugs. If they are not, the lugs should be removed and the connections remade. Before connecting the lugs to the studs, all contact surfaces should be thoroughly cleaned and nuts drawn up tight.

St. Louis, Mo. GEORGE L. LEISHER

Fault in Panel Board Caused Heating

IF THE fuse clips are not overloaded there are several other factors which might cause excessive heating. The cable terminals should be carefully examined and faced off with sand paper to make sure there are no pits in the copper to cause poor contact. The same applies to washers and locknuts. If the studs and clips are not cast in one piece, loose riveted connections between the two may cause the trouble.

One baffling case which caused me much trouble before it was located was caused by current-carrying material in the slate panel. This was of such high resistance that its presence was detected only by the use of a megohmeter connected between the clips. After we cut a shallow channel in the surface of the slate between the clips and filled it in with sealing wax, the heating stopped.

Rochester, N. Y. LAWRENCE F. FULLER

SUPERCHARGER OR ADDED DIESEL TO INCREASE CAPACITY

ANSWERS to September Question 2

THE QUESTION

WE HAVE *two 500-hp., 4-cycle diesels in a plant 5,000 ft. above sea level. Recently load has increased and we would like to increase plant capacity to about 1,200 hp. Is it preferable to add another engine or will superchargers solve our problem more economically?*

—W. R. O.

Depends on Duration Of Peak Loads

SUPERCHARGING the two 500-hp. diesels to give a 30 per cent increase of air pressure at the intake should allow a maximum total load of 1,200 hp. That load is somewhat beyond the rated capacity of the en-

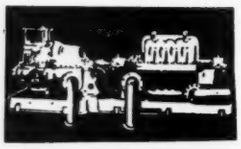
gines and would probably cause trouble with cooling and lubrication systems if long continued. If loads of more than 1,000 hp. are to be carried for periods of less than an hour, superchargers should give satisfactory results. If the periods of peak load are longer, additional units should be installed.

In case local conditions indicate a further increase in demand within a short while or in case the old engines are nearly ready for retirement, it would probably be more economical to buy a new unit.

Clemson College, S. C. D. H. SHENK

Compare Costs

POWER produced by any internal combustion engine is practically proportional to the weight of charge taken into the cylinder. Diesel engines commonly require about 24 lb. of air per pound of fuel. Based on a rate of 0.4 lb. of fuel per b.hp.-hr., 9.6 lb. of air are required per b.hp.-hr. At sea



level this air will occupy about 125 cu.ft. Barometric pressure at 5,000 ft. elevation is 24.7 in. of mercury against 29.92 at sea level. The same amount of air at 5,000 ft. elevation occupies about 152 cu.ft. About 3,000 cu.ft. of air are required per minute to develop 1,200 hp.: $\frac{152 \times 1,200}{60} = 3,040$

If the engines now develop 1,000 hp. at 5,000 ft. elevation, the weight of air put into the cylinders will have to be increased 20 per cent if the horsepower is to be increased to 1,200. This means increasing the pressure at the beginning of compression to 29.7 in. of mercury. About 30 hp. are theoretically required to compress 3,000 cu.ft. per min. from 24.7 to 29.7 in. By the time efficiencies are allowed for, engine horsepower is about 50.

Whether to use a supercharger or not depends on two or three conditions. If there is to be no further increase in load the supercharger is probably the more economical, otherwise it is probably only a question of time until an additional engine will have to be installed anyway. Under these conditions it is probably advisable to purchase the engine now.

The immediate problem is the balancing of fixed charges on a supercharger unit of 3,000-c.f.m. capacity, the cost of 50 hp. to drive it, and the maintenance charges on the supercharger against fixed charges on a 200-hp. diesel and its maintenance charges. However, probably future growth will modify this situation to quite an extent and should be given careful consideration.

Corvallis, Ore. WALLACE H. MARTIN

Favors Supercharging

THE advantages are heavily in favor of supercharging the installed engines to the desired output of 1,200 hp., rather than the addition of another engine. Supercharging is the cheapest way to increase capacity. First cost is lowest and better fuel and lubricating oil economy can be expected.

A 200-hp., 4-cyl., 4-cycle, 11½x15-in., 400-r.p.m. diesel suitable for operation at 5,000 ft. elevation can be obtained for $11,375. This engine is rated 240 hp. at sea level.

If the power developed in the plant is used for electrical generation, a motor-driven centrifugal blower may be used to supply sufficient air to the two 500-hp. diesels to boost their combined output to 1,200 hp. If 60-cycle current is generated, a centrifugal blower driven directly by an induction motor at 3,500 r.p.m. may be obtained complete with control for $1,180. If direct current is generated, a centrifugal blower driven through step-up gearing from a shunt motor may be obtained for $1,600. A Roots blower driven through a reduction gear from a shunt motor will cost slightly more, but will have somewhat better efficiency than the centrifugal.

I would not recommend using a mechanical drive geared centrifugal blower to supercharge low-speed 4-cycle diesels, however, because the torque impulses are heavy and of low frequency. These impulses would impose severe stresses on the step-up gearing, the ratio of which would need to be 10 to 1, or more. Step-up gearing built to withstand these impulses would be of heavy construction and expensive.

If the plant load consists of air compressors, a supercharger of the "mechano-thermo" type* would be the simplest solution. First cost would be around $600 and no maintenance would be required. Efficiency is good.

Some operating people associate supercharging with overloading. These engines will not be overloaded if the combined output is boosted from 1,000 hp. to 1,200 hp. by supercharging 2½ lb. per sq.in. to sea-level pressure. As far as cylinder size and bearings are concerned, the 500-hp. diesels are really 600-hp. engines de-rated for operation at 5,000 ft. elevation on account of the corresponding reduction in air density at that altitude. If the plant is operated carefully, with proper attention to temperatures and lubrication, there is no reason why a moderate amount of overload beyond 1,200 hp. should not be carried. How much depends entirely upon the facilities for cooling, lubrication and judgment of the operator.

*Patents on my "mechano-thermo" supercharger are still pending, so for obvious reasons I cannot offer information for publication at this time. However, I will be pleased to furnish information individually to W.R.O. and others who may be interested.

New York, N. Y.
T. STARLING WINTERS

Favors New Engine

DUE to lack of data, the question cannot be answered positively. If the plant is an electric generating station, supercharging can only be carried to the point where the engines develop sea-level rating. This is due to the rating of the generators and not to that of the engines by installing larger generators and superchargers for the engines the power could be developed, but cost would probably run as high as that of a new engine. With a new unit of the same size as the present ones he could carry the regular load and have one unit out for repair.

Power for November, 1932 (page 232), explains that exhaust gas turbine superchargers are obviously expensive, especially when applied to existing engines, and become prohibitive when the engine's normal rating is below 500 or 600 b.hp. The majority of these superchargers are of the exhaust turbine type and are used on large engines where the operating conditions involve long runs at fairly constant loads.

W.R.O. can supercharge his engines so they will develop 1,200 hp., but I am of the opinion that the economical solution would be a new unit.

Walthill, Neb. WM. W. DINGWALL

Blower Is Cheaper

THE density of 1 cu.ft. of air at sea level is about 0.081 lb., at 5,000 ft. it is 0.067 lb. Since the power of a diesel varies almost directly with air density, engine power is 0.067 ÷ 0.081, or 0.827 of sea level rating. Therefore the diesels are only developing 500 × 0.827 = 413.5 hp., or say 415 hp. per engine. The two engines are producing 830 hp. at 5,000 ft. In order to produce 1,200 hp. at this altitude, superchargers or an additional engine would be required. To produce 1,000 hp.—sea-level rated horsepower—at this altitude would require 1,000 ÷ 0.827 = 1,209 hp., or two 600-hp. engines. Three 500-hp. engines (sea-level rating) would produce about 1,240 hp. at 5,000 ft.

But installation of an additional 500-hp. engine would cost considerable money, in

addition to added operating expense. A supercharger would appear to be a cheaper solution. A horsepower can be developed from about 0.43 lb. of oil. In practice, 1 lb. of oil requires 30 lb. of air for combustion. Therefore the two 500-hp. engines will require 1,000 × 0.43 × 30 = 12,900 lb. of air per hr. Since air density at 5,000 ft. is 0.067, the air will run 1 ÷ 0.067 = 14.92 cu.ft. of air per lb. Call it 15 cu.ft. per lb. Then 12,900 × 15 = 193,500 cu.ft. per hr., or 3,225 cu.ft. per min. Now, if the engine is surcharged or supercharged by a blower, pressure should be raised about 3 lb., and the work will be about: Hp. = Q ($p_1 - p_2$) ÷ 33,000 × 0.8, where Q is the cu.ft. of air compressed per min., p_1 the final pressure and p_2 the initial pressure of the air *per sq.ft.* absolute. The pressure of air at 5,000 ft. is 12.2 lb. abs. Substituting in the formula, we have Hp. = 3,225 (15.2 — 12.2) × 144 ÷ 33,000 × 0.8 = 58.

Call it a 60-hp. blower, obviously cheaper to buy and operate than an additional 500-hp. engine.

Boling, Texas THOS. H. POMEROY

THE ENGINEER'S BOOKSHELF

N.E.M.A. Standards

NEMA Motor & Generator Standards—*Published by National Electrical Manufacturers Association, 165 East 44th St., New York, N. Y. Index. 176 pages, 8 x 10½ in. Flexible linen binding. Price, $2.*

Superseding and greatly amplifying the 1930 edition, this 1934 edition brings together much information not heretofore published. It constitutes a reference work of practical information concerning manufacture, test and performance of a.c. and d.c. motors, generators and combinations of both. The material is arranged in readily usable form. Various kinds of motors, generators and combinations are treated in separate sections, each practically complete in itself, making it possible to find in one place most of the standards pertaining to a given kind of rotating apparatus. Major sections include universal motors, small d.c. motors, small a.c. motors, large d.c. motors, large a.c. motors, large induction motors, large synchronous motor, a.c. elevator motors, a.c. crane motors, d.c. generators, synchronous generators, motor-generator sets, synchronous motor-generator sets. Sections added in this edition include d.c. generators (general-purpose sizes) buffer and grinder motors, motor-generator sets (150 kw. and smaller) motion picture motor-generator sets. A section on definitions defines over 150 terms commonly used. Standardized mounting dimensions for motors are included, the first time in print. Ten-page index.

Electron Tubes

Electron Tubes in Industry (1934)—*By Keith Henney, associate editor, Electronics. Published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York, N. Y. 490 pages, 6 x 9 in. Indexed and illustrated. Clothboard covers. Price $5.*

Electronics and the electron tube, within the last few years, have been taking an increasingly important place in industry in non-communication uses. Developments in tubes and applications to process have come with startling rapidity, and are still coming so rapidly that no textbook a year or two old can begin to cover the subject adequately. This work thus is particularly timely and answers the need of those many engineers who must work with these power-converting and applying units. This is a thorough presentation of the practical aspects of electronics—what the electron tube is doing to make processes simpler, cheaper, safer and in modernizing systems of control. The text describes in detail amplifier, rectifier and other tubes and photocells and their applications in industry, including circuit diagrams, performance charts and comparisons with other types of apparatus. Power engineers will be particularly interested in the data on amplifiers, recorder and volt-meter applications, relays, measurement of displacement, humidity, viscosity, time intervals, temperature and dozens of other new power applications of these tubes.

BRIEF REVIEWS

Brown's Directory of American Gas Companies (1934). *Published annually since 1887 by Robbins Publishing Co., Inc., 9 East 38th St., New York, N. Y. 624 pages, 6 x 9 in., clothboard covers. Price $15.*—Detailed annual statistics of gas companies (manufactured, butane and natural) in the United States and Canada, also a catalog data section containing essential information concerning gas equipment, appliances, supplies and services.

Current Hydraulic Laboratory Research in the United States. *Report No. II-2, 1934. Published by U. S. Department of Commerce, National Bureau of Standards, Washington, D. C.*—This mimeographed report of 70 pages includes the description of current projects in the United States hydraulic laboratories, current hydraulic research in foreign laboratories, completed projects, giving abstracts and references, translations, foreign pamphlets received and in files, list of principal French hydraulic laboratories, U.S.S.R. Commission for Exchange of Hydraulic Laboratory Research Results, notices of publications on hydraulics and hydrology, and an index of projects.

Hardness of Public Water Supplies in the United States. *In a 98-page table in Water-Supply Paper 658 of the Geological Survey, U. S. Department of the Interior. Copies for sale by Superintendent of Documents, Government Printing Office, Washington, D. C., 15 cents.*—Chemical composition of public water supplies of 670 places, serving 56 million consumers, including brief descriptions of the supply systems as to source and treatment. Text also includes brief discussion of treatment of public, industrial and domestic supplies, and map indicated weighted average hardness by states of supplies, for which analyses are given.

Five-Place Table of Natural Trigonometric Functions to Hundredths of a Degree (1934). *Compiled by Amelia De Lella, Central Station Engineering Department, General Electric Co. Mimeographed on 8 x 10-in. sheets, paper covers. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York, N. Y. Price, $1.*—Just as its name indicates, this is a convenient working table to nearest hundredths of a degree. Sines, cosines, tangents and co-tangents for each hundredth of a degree are given and, like most tables, the values, as read from the top of the page downward, are between 0 and 45 deg., and from the bottom of the page upward, beginning at the back of the book, from 45 to 90 deg.

Table Cleaning of Fine Coal From the Thompson and Woodstock Beds of the Cahaba Field, Alabama (1934). *By A. C. Richardson, B. W. Gandrud and W. D. Musgrove.*—A mimeographed report of the investigations by the U. S. Bureau of Mines. Published under number R.I. 3234—A 19-page report with 13 tables on the second largest coal-producing area of Alabama.

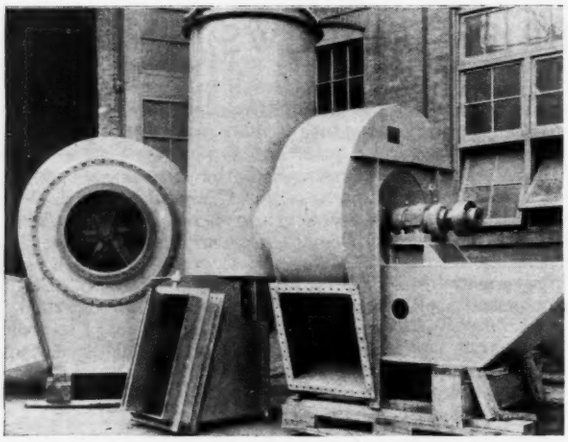
Bibliography of Information on Air Conditioning. *Compiled by the U. S. Department of Commerce, Bureau of Foreign & Domestic Commerce, Washington, D. C. 45 pages. Mimeographed.*—This book includes a list of trade associations, institutes and societies interested in air conditioning, magazine articles, foreign magazine references, government reports, addresses, books, pamphlets and releases, and anticipated literature on the subject.

Jahrbuch der Verkehrsdirektion (1933) *(Year Book of the Berlin State Electrical Works). Published by Berliner Stadtische Elektrizitatswerke Akt.-Ges., Berlin, N. W. 7, Schiffbauerdamm 22, Germany.* 124 pages, 5¼ x 8¼ in. Cloth board covers. 67 illustrations—Regular annual report with considerable information on the electricity supply of Berlin.

Steam Generation (1934). *A report of the Steam Generation Subcommittee of the Prime Movers Committee, Edison Electric Institute. Published by Edison Electric Institute, 420 Lexington Ave., New York, N. Y., as Publication No. B8. 60 cents to members and $1.50 to non-members*—Contains statements by operating companies and manufacturers on burning fuel oil in coal-fired boiler furnaces, stokers, pulverized fuel equipment, stack gases, boiler-water circulation, water gages and columns, carry-over of moisture and solids in steam, feed-water treatment, and laying up equipment.

Electricity Commission Report on the Measures Which Have Been Taken in this Country and in Others to Obviate the Emission of Soot, Ash, Grit and Gritty Particles from the Chimneys of Electric Power Stations (1932)—*By a committee appointed by the Electricity Commissioners. Published by H. M. Stationery Office, Adastral House, Kingsway, London, W. C. 2, England. 59 pages. 7½ x 10½ in. Paper covers. Eight tables and 11 appendices. Price 5s. net.*—Just as its name implies, this report is very complete on plants and practice in England, Germany and France, showing the problems of dust extraction in plants under particular types of firing, the dispersal of chimney gases and uncaught dust, plant efficiency and testing, measurement of dust content of flue gases, and under Section 6 both wet and dry types of flue dust plants, including water film, water spray combined, cyclones and electrostatic precipitators, showing treatment of and disposal of dust. Section 5 deals with capital and operating costs. The tables give types of plants installed in particular stations, grading of dust, rate of fall of dust, mean wind velocity, efficiency tests and similar data, and the appendices describe various types of dust extraction plants and various methods of making dust studies.

WHAT'S NEW IN PLANT EQUIPMENT



Acid-Proof Rubber Fan Covering

Corrosion is avoided in fan housings by a specially developed acid-proof rubber compound vulcanized to metal surfaces. Holds so tenaciously that cannot be taken off without destroying.

Manhattan Rubber Mfg. Div., Passaic, N. J.

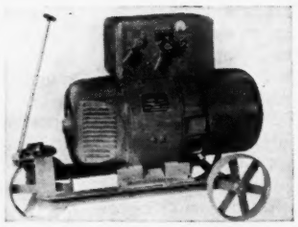
Insulating Material

Laytex dielectric derived directly from latex (milk of rubber tree). Liquid is solidified on conductors before they come into contact with any mechanical support, thus centering conductor accurately and giving uniform thickness of dielectric. Tensile strength of dielectric 5,000 lb. per sq.in., elongation at rupture 750 per cent, set in 2-in. gage length 0.25 in. (tests at 65 to 90 deg. F.). Electrical properties: dielectric strength 800 volts per mil, insulation resistance constant 54,000 (more than twice that of best-grade rubber compound required by A.S.T.M. specifications), relative specific inductive capacity 2.5 (air as unity). These properties permit thinner dielectric wall, making finished conductor lighter in weight and smaller. In some cases reduction amounts to 50 per cent in weight, 25 per cent in diameter. So far applied to smaller conductors for multiple-conductor flexible cables, switchboard wiring, portable cord, telephone, etc.

United States Rubber Products, Inc., P. O. Box 12, Station G, New York, N. Y.

Arc-Welding Set

Portable, single-operator sets embodying self-stabilization to give better performance throughout entire welding range with



any type electrode. Called WD-30 line, has no external reactor, resistor or separate exciter. Self-stabilization makes welding arc both "peppy" and stable at all times. Separate control for adjustment of welding current and welding voltage, both on dead-front panel at top of machine. On this panel is also switch handle for reversing polarity and instrument with selector switch for indicating welding current and welding voltage. High operating efficiency. All working parts protected from water or damage. Entire set low-hung on 3-wheeled truck so can be tipped 22 deg. from vertical safely.

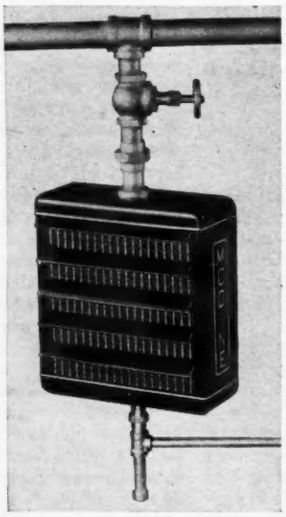
General Electric Co., Schenectady, N. Y.

Oil Seal

Klozure oil seal has four parts: adapter, spreader, sealing member and case. Adapter is metal ring flanged to exert constant pressure on spreader, to hold packing ring in place and to prevent leakage between outside diameter of packing ring and case. Spreader is flexible metal ring with saw-tooth edges formed in V shape to fit into convex face of sealing ring to help press sealing lips outward, thus supplementing resiliency of sealing ring. Sealing ring or packing is U-cross-section composition which is dense, grainless, resilient, non-porous, oil-resistant, heat-resistant, non-abrasive tough durable and with low coefficient of friction. Molded to exact dimension. Case or housing is metal enclosure with edge flanged over adapter ring. Usually steel but can be stainless steel or aluminum. Metal parts may be

cadmium plated if required. Design claimed to permit units with identical characteristics. Pressed into bore or housing when applied. Standard sizes for shafts ⅜ to 3 in. in diameter. Cases for most shaft sizes in several outer diameters and depths. Booklet available.

Garlock Packing Co., Palmyra, N. Y.



Unit Heaters

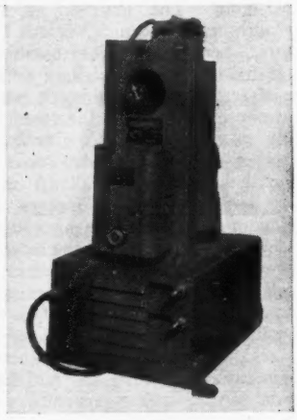
16 steam, 14 hot-water sizes in this suspended, propeller-fan type unit which hangs directly from steam line and requires no brackets or straps. Rotatable 360 deg., except for twin-unit models. Individually controlled.

Heating Div., Modine Mfg. Co., Racine, Wis.

Coated Arc-Welding Electrode

Heavily-coated GE Type W-23 is used for high-speed high-quality welds in flat position. Either manual or automatic arc-welding with either a.c. or d.c. (with latter use reversed polarity). Economy at higher speeds, larger diameters and higher current values than usual. Fuses uniformly with side walls. Welds meet requirements of A.S.M.E. Class 1. Ultimate tensile strength, stress relieved, 65,400 to 66,700 lb. per sq.in.; unrelieved, 67,400 to 71,300 lb.

General Electric Co. Schenectady, N. Y.



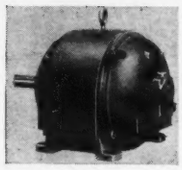
75-Amp. Welder

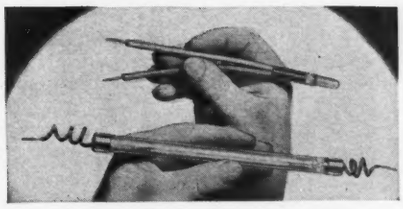
Small-motor-generator unit for use on thin sheets, plates and shapes. Usable on any a.c. supply. Used electrodes as small as $\frac{1}{16}$ in., permitting work on metals down to 24 gage. 25-volt arc with current range 20 to 100 amp. Generator single-operator variable-voltage type with 75-amp. N.E.M.A. rating. Motor "Linc Weld" 3-hp. squirrel-cage induction type for across-the-line starting. Supplied for a.c. 110 and 550 or special voltages, 3, 2 or 1 phase; 60 and 50 cycles as desired. Connections also readily available for 220 and 440 volts. Dual control provides independent adjustment of open-circuit voltage and welding current. Unit 20x 16x40 in. high, arc-welded steel, with two small wheels on base.

Lincoln Electric Co., Coit Rd. and Kirby Ave., Cleveland, Ohio.

Splash-proof Induction Motor

Splash-proof, weather-proof and drip-proof, indoor or outdoor service, special cast frame and end brackets and cast conduit box. Baffle plate cast integral with inner side of motor bracket prevents splashing from reaching windings. Ball or



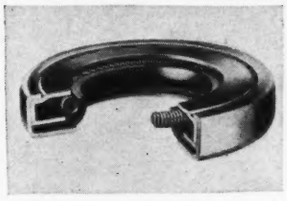


sealed sleeve bearings. Rated 50-deg. continuous in both squirrel-cage and wound-rotor types. Squirrel-cage unit shown.

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

Oil and Grease Seal

Type BB seal consists of outer steel case which locks seal assembly permanently, equalizing annular garter spring pressing equally all around sealing member itself. Latter may be of any



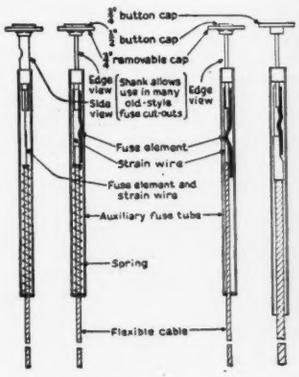
material to suit job, usually a processed leather, Saetan. Outer case has press-fit accuracy of 0.002 in tolerance, plus or minus, on diameter. Catalog available.

National Motor Bearing Co., 1225 78th Ave., Oakland, Calif.

Cable-Type Fuse Links

Cable-type tension fuse links is for all types and makes of distribution fuse cutouts operating on expulsion principle at 15,000 volts or less. To relieve fusible element of tensile stress, when link is used in indicating or drop-out cutout, strain wire of Monel metal is used in parallel with fusible element. Links can be coordinated with each other and with G-E low-temperature fuse links. Coordinating charts available. Bulletin GEA-1816A.

General Electric Co., Schenectady, N. Y.



"Voltage" Fuses

"Tattelites" are neon discharge tubes with breakdown potentials of 100, 250, 500, 1,000 and 2,000 volts which will protect equipment against excessive voltages just as regular fuses protect against excessive currents. They operate by shunting out overloads. Used to prevent insulation breakdowns; protect meters, instruments, transformers, condensers, gaseous rectifiers; leak-off static charges from machinery; test for blown fuses, defective resistors and condensers; indicate resonance peaks and high-tension lines, and are used in making saw-tooth oscillators, trigger circuits, bleeders for d.c. power supplies and stroboscope effects. Pages 9 and 10 of Catalog No. 6.

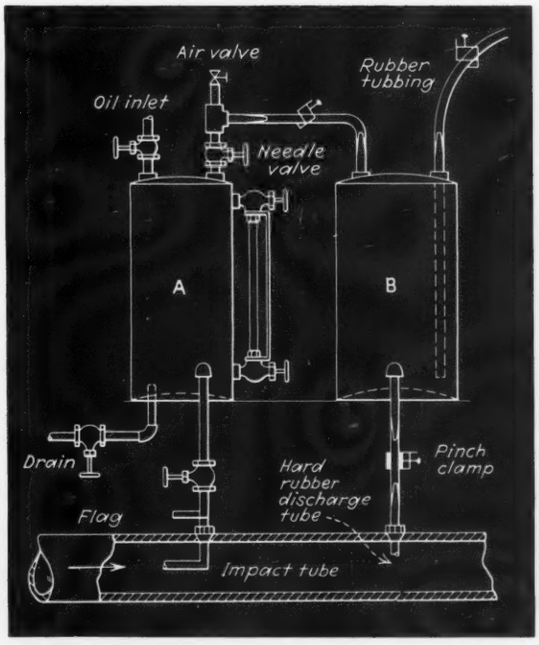
Littlefuse Laboratories, 1772 Wilson Ave., Chicago, Ill.

Corrosive Solution Feeder

H-O-H proportioning principles now applied to corrosive solution feeder designed primarily for feeding hypochlorite solutions. Simple design, protected against corrosion by hard rubber connections and rubber-lined tanks. In drawing, *A* is filled with inert chemical fluid lighter than the reagent and lighter than the main fluid throughout (red oil). Needle valve control placed so that it is continually filled with this inert chemical, thus is protected from corrosive action of reagent. As main fluid flows through line, a proportionate portion rises into *A*, forcing red oil through needle valve into compartment *B*, displacing reagent through hard-rubber pilot tube into line.

Machine is recharged by shutting off connections from pitot tubes and allowing reagent to flow into compartment *B*, forcing red oil to return to compartment *A*, while main fluid which has risen into *A* is drained and run into sewer. This takes less than 5 min., and units are large enough that recharging is required only at long intervals. Unit claimed absolutely proportionate, starting, stopping and varying in response to flow. Used in purifying swimming pools, municipal water plants, etc.

D. W. Haering & Co., Inc., 3408 Monroe St., Chicago, Ill.

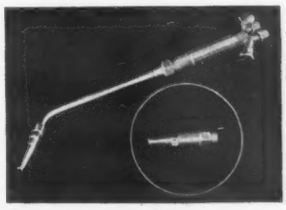


Motor-Gear Reduction

(Photo lower right)

This adaptation of Synchro-gear motor, which gives speed variations of 2 to 10,000 r.p.m., converts high motor speed to low-speed multiple torque. Instead of conventional train of gears on one end of motor frame. This unit is self-contained motor with single base embodying geared transmission foundationed on heavy gear pedestal base to withstand high torques. Full rated horsepower delivered to take-off shaft. Assembly occupies practically no more space than standard motor. Fully enclosed gear compartment. Highest-speed gears not fully submerged in oil, thus avoiding foaming and resistance. Gear ratios may be changed at place of installation. Bulletin.

U. S. Electrical Mfg. Co., 1510 So. Western Ave., Chicago, Ill., or 206 E. Slauson Ave., Los Angeles, Calif.



Blowpipe Head

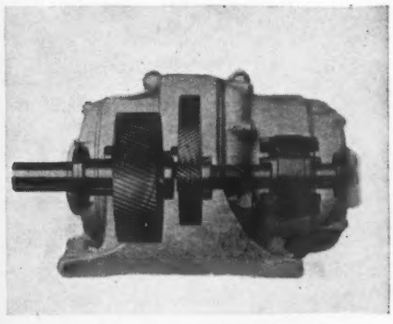
Multi-flame Linde-Welding head is for use on W-17 or W-22 Oxweld blowpipes. Consists of special chromium-plated stem and tip, available in three sizes to suit pipe size. Tip designed to give three flames, main welding flame, and two smaller auxiliary flames, latter positioned to preheat both edges of V ahead of welding. Savings claimed 25 per cent on rod, one-third in welding time.

Linde Air Products Co., 30 East 42nd St., New York, N. Y.

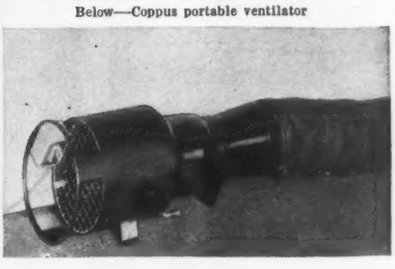
Portable Ventilator

(Photo at foot of page)

Used especially for exhausting fumes, gases and foul air from enclosed spaces, this portable ventilator can be placed either horizontally or vertically. When placed vertically, ventilator rests on ring attached to inlet so that fumes and gases are removed from lowest possible point. This is especially important when ventilating storage tanks, bins, pipe galleries or cable vaults. Compact unit; can be lowered through 14-in.



Above—U. S. motor-gear reduction
Below—Coppus portable ventilator



diameter opening. Total weight including motor is 80 lb., thus readily portable and operable by one man. 8-in. diameter flexible tubing may be used to carry off fumes and foul air at rate of 1,500 cu.ft. of air per min. Bulletin 168 gives details.

Coppus Engrg. Corp., Worcester, Mass.

Heavy-Duty Gear Lubricants

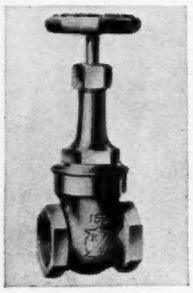
Viscous oils added to line of "Sta-put" lubricants for extreme pressure gear lubrication. This 600 series will withstand from 3 to 5 times the load that straight mineral oils of same type, without these characteristics, will withstand. Torque readings show friction reduction of 30 to 50% as compared with same oils before treatment. Oils for units from light-duty speed reducers to heaviest worm or herringbone units operating under shock loads.

E. F. Houghton & Co., 240 W. Somerset St., Philadelphia, Pa.

Oil Circuit Breakers

FHKO-339 line of outdoor oil-blast circuit breakers now includes voltage ratings over 34.5 kv., removable mechanism box and cover being eliminated. Operating mechanism frame now welded to breaker dome. Only dome openings are two bushings, handhole with bolted cover for access to crank, and small plug holes for inserting pins in linkage. This reduces length of gasketed joints and chances for water leakage. Horizontal operating rod between poles carried in weatherproof housing of pipe. In frame-mounted circuit breakers, bushing current transformer leads are carried in similar pipe near centerline. 46-kv. breakers have L-type heavy-oil-filled bushings. Higher voltage breakers have F-type bushings filled with light oil. On 69-kv. unit, new weighs 690 lb. less than old, with 30 ft. less welding and 17 ft. less gasketing.

General Electric Co., Schenectady, N. Y.



Rising-Stem Heavy Bronze Gate Valves

Fig. 45 valve, companion to Fig. 23 with stationary stem, is a rising-stem heavy standard bronze gate valve for 150 lb. working steam pressure and 250 lb. working water, oil or gas pressure. Operating mechanism employs solid-wedge disks without small, quick-wearing parts. Flexible connection between disk and stem to avoid binding or springing. Stem high-strength bronze composition, with many contact threads in bonnet. Bonnet hexagon extra large and close to body to avoid distortion under wrench pressure. Deep stuffing box with gland and square-section molded packing. Large, non-heating malleable-iron handwheel held to stem by nut. Heavy wide, pipe-end hexagons with long thread.

Kennedy Valve Mfg. Co., Elmira, N. Y.

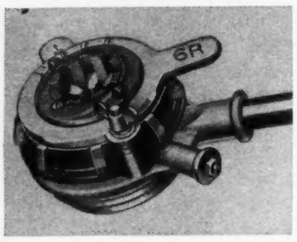
Condenser for Condenser-Start Motors

Wide variety of electrolytic and oil-filled condensers for condenser-start motors obtainable in round rubber-insulated or standard cans with or without insulating jackets, any desired terminals. Hermetically sealed. Special composition spacer protects unit against surges. Internal metal parts aluminum, avoiding electrochemical action and corrosion. Oil-filled units for condenser-transformer motors and power factor correction. Oil quantity carefully worked out so that expansion under heat forces oil through section leaves, exerting cooling action.

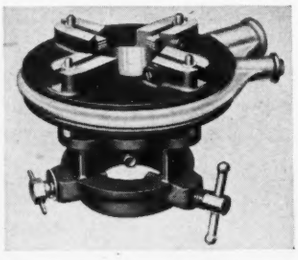
Aerovox Corp., 70 Washington St., Brooklyn, N. Y.

Diestocks

No. 6-R Beaverette ratchet stock is a "one-piece" unit capable of threading ¾- to 2-in. pipe without changing dies or



bushings. Easily adjustable to cut oversize or undersize threads. Universal pipe guide centers pipe accurately. Close nipples can be cut. Locking device on top. Two sets of dies always in tool—required because of difference in pitches. Right- or left-hand. ⅜-in. dies on order. No. 38-R Beaver ratchet for 8-thread, 2½- and 3-in. pipe. Straight-line pull. Separate dies

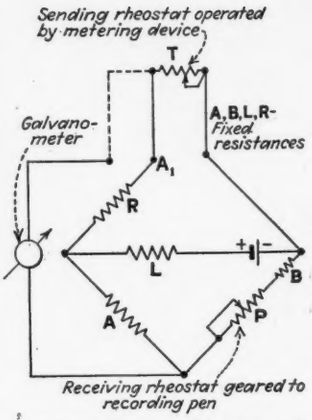


for each size. Interchangeable die segments. Drip threads or close nipples. Patented grooved-bolt centering device—no loose bushings. Right-hand only.

Borden Co., Warren, Ohio.

Electronic Relay Telemetering System

Transform minute electrical currents into useful forces in new telemetering system for remotely measuring pressure, temperature, liquid level and other factors. Electronic-relay operated Galvatron receiving element records as many as four factors on one 12-in. circular chart. Transmitting element consists principally of variable-resistance unit operated by



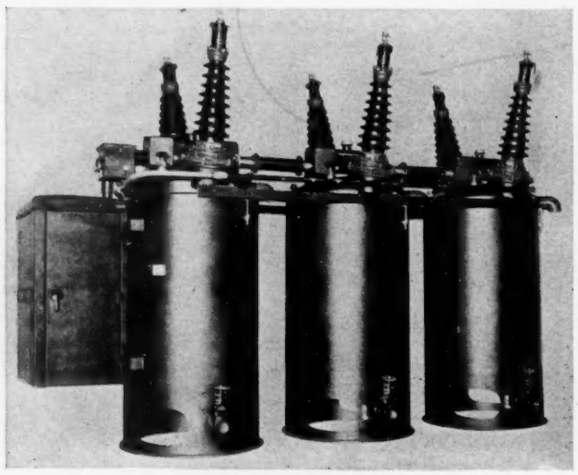
metering device. In case of float-operated transmitter for liquid level, a float moves a rheostat. For distances to 10 mi., accuracy to 1 per cent scale reading obtained by using 3-wire connection between metering device and remote recording apparatus, with telephone lines or equivalent as transmitting medium. Uses only small current because of installed vacuum-tube amplifier. Dry cells will supply current necessary for from 6 mo. to 1 yr. Because of small current and voltage, no danger of interference between adjacent telephone lines and recording circuit. When indications are transmitted more than 3 mi. with only two wires, potentiometer circuit is recommended. Additional records up to 4 can be obtained with 1 added wire per record. Thus 2 records require 3 transmission wires. Illustrated is wiring diagram.

Bailey Meter Co., 1050 Ivanhoe Rd., Cleveland, Ohio.

A.C. Arc-Welder

This line includes transformer units, electrodes and automatic welding heads and control. Primarily for heavy-current automatic welding. A.C. process avoids magnetic blow in arc and gives slightly greater welding speeds and better penetration in intricate corners. Three sizes with 1-hr. ratings of 500, 750 and 1,000 amp. Primaries wound for 220, 440 or 550 volts; 60, 50 or 25 cycles; single phase. Attachments for reducing secondary open-circuit voltage to about 50 per cent of normal 80, 90 or 100 volts and for obtaining currents down to 10 per cent of 1-hr. rating. Transformers high-reactance type, air-cooled, enclosed in cylindrical shells. Variable reactance to obtain full welding range on any of three secondary open-circuit voltage settings—latter selected by taps on primary. Used with Type W-23 electrode.

General Electric Co., Schenectady, N. Y.

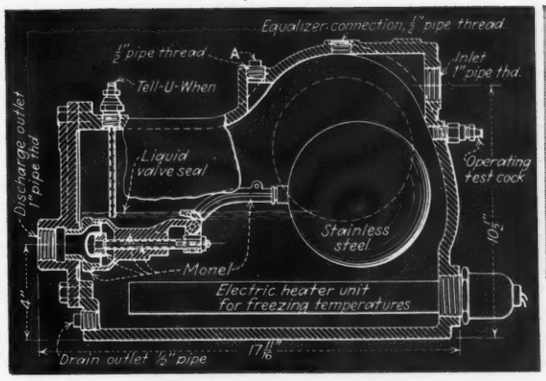


Stoker and Combustion System

V. M. automatic periodical stoker may be operated by hand, continuously or at desired intervals automatically. Stoker section may be automatically operated, alternately or simultaneously at any required periods and in conjunction with V.M. mechanical draft. New type stoker bar heavily reinforced and with greater capacity. Units for any type or size of boiler without altering floor. Interval system of operation claimed to reduce power required and give longer life to stoker bars. Fuel fed from front to rear, by alternate and periodical rising and lowering of feeding stoker bars. Complete operation requires 1 min. Stoker bars driven by motor through reduction box and 2-r.p.m. shaft (under ordinary conditions). Segmental gears on stoker shaft engage pinion gears below, which through crank and connecting rod, operate one set of stoker bars; other set or sets operated similarly. Segmental gear, by moving ¼ turn, revolves pinion gear a full turn, thus completing 1 cycle for a given group of bars in about 20 sec. Bars not only raised, but lowered, mechanically, avoiding sticking in elevated position. For periodical operation segmental gears are alternately engaged and disengaged by a timer, which cuts out gears for required interval.

Mechanical draft and combustion system operates automatically to supply required quantity of air in accordance with steam demand. Air also is controlled by hand. Combination stoker and draft system claimed to result in clean fire at all times and to double steam capacity. Will burn any kind of coal.

V. M. Engrg. Co., 916 G St., N.W., Washington, D. C.



Trap

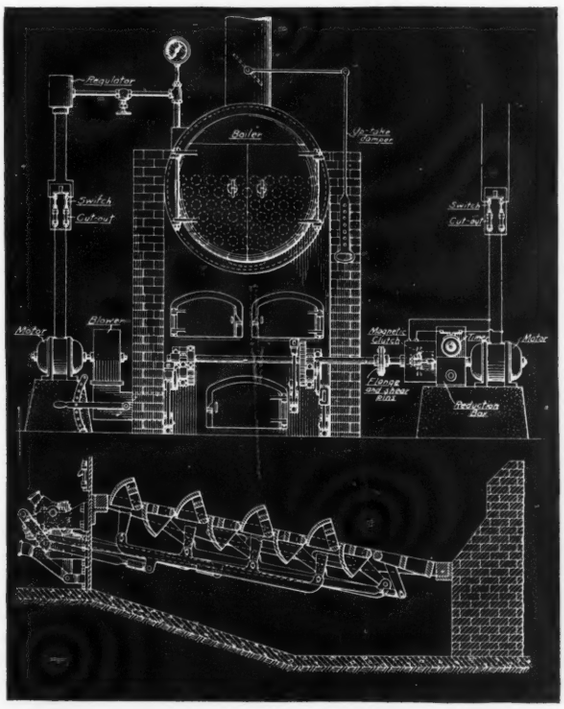
Multi-gravity trap automatically handles water, oil or any two or more liquids of varying specific gravities coming from aftercoolers, receivers or any other apparatus. Works equally well at all pressures without change of orifice. Ready to operate as soon as connected. Valve Monel metal, float stainless steel. If operating properly, trap will emit either gas or air when operating test cock is opened, depending on service. This proves that trap is handling the liquids of lighter specific gravity than water, otherwise they would lie on top of water and build up in trap. Tell-U-When shows whether valve is tight or leaking. If, when opened, it emits liquids, it is tight, if it emits air or gas, valve is leaking. Electric heating unit added when unit is used out-of-doors and subjected to freezing temperatures. When operated only during day can be drained each night, thus making heating unit probably unnecessary.

J. E. Swendeman, Inc., 171 Camden St., Boston, Mass.

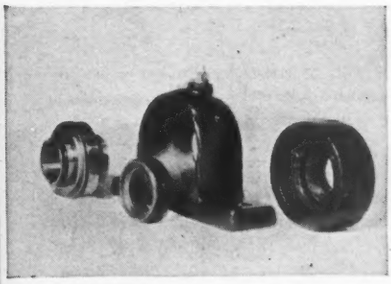
Meter Lightning Protector

Thyrite meter-protector, mounted as part of meter installation, is intended for use on relatively long and exposed secondary circuits up to 650 volts on polyphase watthour meters. Impulse voltage is limited to less than crest value of standard 60-cycle test voltage for new meters. Mounted either on cabinet or meter connection box. Consists essentially of three single-pole protectors, each made up of Thyrite disk and small series gap. Contained in steel case 5½x4⅛x2⅜ in.

General Electric Co., Schenectady, N. Y.



Above—Meter lightning protector
Below—Drop-out fuse cutout



Cork-Insulated Ball Bearing Pillow Block

Wide inner-ring type bearing with Fafnir self-locking collar. Deep-groove large-ball design giving high load capacity, thrust as well as radial. Housing cast iron with ribbed base, compact. Pre-lubricated when assembled, thus will run a year without attention. Lubrication renewable by means of grease tubes as proper fitting is included in housing. Insulation is cork pad which fits into housing and around bearing itself. Treated so that no separation of particles can occur. Acts also as seal against escape of lubricant or entrance of dirt. Self-aligned, easily assembled, silent.

Fafnir Bearing Co., New Britain, Conn.

Indoor Disconnecting Switches

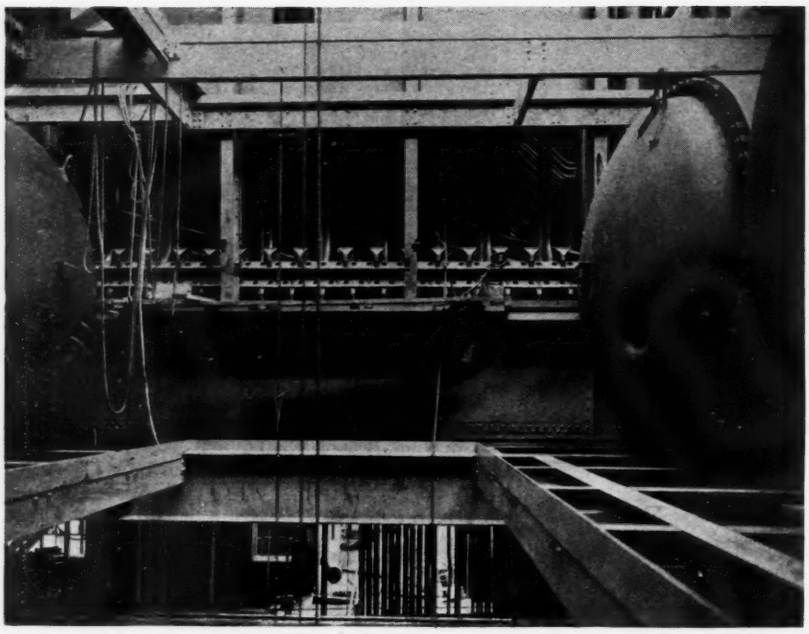
Ratings as high as 1,200 amp. at 5,000 volts and silver-to-silver contacts are featured in this line. Silver, specially applied, eliminates oxidation, and surfaces have shown no failure in 30,000-operation test. Line includes hook-operated, single- and double-throw, double-blade transfer switches with half- or full-capacity blades, single-throw tandem transfer switches with full-capacity blades, and group-operated switches controlled manually or electrically.

General Electric Co., Switchgear Division, Philadelphia, Pa.

Inclosed Indicating and Drop-Out Fuse Cutout

Porcelain-inclosed cutout. Gives positive evidence that circuit is open either by conventional drop-out or by visual indication of blown fuse link by opening door cutout at lower end. Door bottom protrudes only 1¼-in. when fuse link is blown, thus protects live contacts and mechanism from weather. Rated at 5,000 volts, 60 amp., with interrupting capacity of 1,500 amp. (r.m.s.) easily convertible from indicating action to drop-out action by lifting out small wire yoke. Designated Catalog No. 9F6A1. Bulletin GEA-1993.

General Electric Co., Schenectady, N. Y.



AFTER SIX MONTHS AT FIRESTONE

Work on the 1,400-lb. pressure steam addition to the Firestone power plant, Akron, Ohio, on Oct. 1, had included the setting of the five evaporators (52,200 lb. per hr. each), three of which can be seen in the foreground. Work on the installation of the 300,000-lb. boiler was going forward rapidly with all of the boiler tubes in place and about 20 per cent of the side-wall tubes finished.

POWER LINES

Wide Variety of Power Equipment To Appear At Power Show

INFORMATION is beginning to be available on the exhibits at the Eleventh National Exposition of Power & Mechanical Engineering in Grand Central Palace, New York, the week of Dec. 3. A number of new products and much information of interest to power engineers generally will be presented at the Show, and preliminary reports show a record-breaking attendance.

Power transmission will occupy an important place in the exhibits, as will insulations suitable for use from lowest commercial temperatures to as high as 1,950 deg. F. Special piping with noncorrosive linings and fittings of the same materials will be shown, including lead-lined and antimonial lead parts for drinking water systems. Power machines for pipe threading and cutting, hand pipe threaders, precision tools, automatic saw filers, pipe welding, silent and roller chain drives, flexible couplings, variable-speed control equipment, speed reducers, motor-reducers, belts and accessories, CO_2 and draft recorders, lubricants, industrial gas analysis test sets, electrical controls and equipment, steam traps, boiler feeders, separators, accessories, condensers, aftercoolers, and dozens of similar products will be exhibited. Piping accessory exhibits will include steel valves and fittings, alloy valves and fittings, even precast concrete conduits.

Refrigerating Machinery Association Meets

The Refrigerating Machinery Assn. held its 21st annual meeting at Hotel Stevens, Chicago, Oct. 22 and 23. A particularly large attendance was reported because of the interest in new technical developments, recent Governmental policies affecting the durable goods industries and industry codification. A. H. Baer, vice-president of Carbondale Machine Corp., reported that satisfactory progress is being made in standardization. D. Norris Benedict, vice-president and general manager of Frick Co., Inc., was elected president of the Association, and J. M. Fernald, general manager of Baker Ice Machine Co., was elected vice-president.

Classification of Diesel Fuels

For some time, A.S.T.M. Standing Committee D-2 on Petroleum Products and Lubrication has been working on a classification of diesel fuels. A table has now been prepared and published for information and criticism. Copies can be obtained from the American Society for Testing Materials, 260 South Broad St., Philadelphia, and criticism and comment should be addressed to Dr. R. P. Anderson, Secretary of Committee D-2.

New $3,000,000 Refinery Unit Makes "Dry-Cleaned" Lubricants

Nov. 1 brought to American users the first lubricants produced by "dry cleaning" with two solvents. The new $3,000,000 "Clearosol" process unit at the Paulsboro, N. J., refinery of Socony Vacuum Oil Co. produces a lubricating oil with the ability to lubricate adequately at engine working temperatures and yet to flow freely at subzero. Now available only to automotive users, the product will be on the market in a few months for severe-service power equipment, notably diesel engines, steam engines and steam turbines.

The trick is clean-cut separation of useful and harmful constituents by selective solvents which will not mix. Lubricating stock is treated simultaneously with liquified propane, which extracts the good, and with "Selecto," which extracts the bad. The two solutions, separating sharply in the extractor, are tapped off for distillation, which releases the solvents for re-use. The liquid residue from the propane distillation is highly purified paraffine lubricant ready for the market. That from the other is a sticky black mass at present usable chiefly for road oil, but with future possibilities as a raw material for chemical manufacture.

Hydro Station Flies Into New Guinea

Four G. E. horizontal waterwheel generators, rated at 875 kva. each, together with associated apparatus, left San Francisco recently. At Lae, New Guinea, the equipment will be loaded, one section at a time, into huge all-metal Junkers freight planes and flown 40 mi. inland to the headwaters of the Bulolo River, where Bulolo Gold Dredging, Ltd., has established a thriving placer mining camp. The four generators, rated at 875 kva. each, are designed to operate at 11,500 volts, 50 cycles, at 600 r.p.m. The largest single pieces are the stators, which have a net weight of 6,545 lb. Boxed for shipment, the stators measure 82x49x97 in.

Wind Power Not Economical In Germany, Say Engineers

Investigations by German electrical engineers have shown no economy in production of electrical energy in that country by wind power plants in competition with existing pit coal and lignite plants, according to reports to the Department of Commerce. Extremely low cost of production per kilowatt-

hour in the pit coal and lignite plants coupled with high installation costs for wind power plants are given as the basis for the findings. Kilowatt-hour cost with pit coal in Germany was placed at about one Pfennig and at about one-half Pfennig with lignite. It was further pointed out that even if coal could be furnished free, cost of production per kilowatt-hour could only be reduced slightly.

Costs of installation for wind power plants would exceed the cost of coal power plants because a considerably larger reserve would have to be provided for. This necessarily higher investment would swallow the profit expected from free energy source, the German engineers found.

Meanwhile, German electrical engineers are studying the suggestion of accumulating superfluous electrical current in the form of electrically produced hydrogen, which could be used for operation of hydrogen motors, heating, etc. This idea is still in the experimental stage and nothing definite concerning its economic advantages, especially whether the considerable costs necessary for transforming, rectifying and actual electrical decomposing would destroy the economic feasibility of the scheme, has been determined as yet.

Welding Clinics Held

Linde Air Products Co., New York, N. Y., held a four-day welding clinic in New Orleans, La., starting Oct. 24. This was the fourth of its type this year, the others having been held in Birmingham, Ala., Houston, Tex., and Cleveland, Ohio. The purpose is to pass on new developments in the oxy-acetylene welding and cutting industry, to assist those who have welding and cutting problems and to demonstrate and give instruction.

POWER IN EUROPE

Rionges hydro-electric plant, largest in the Caucasus, has been officially opened in the Georgian Soviet Republic. It has a capacity of 50,000 kw. and will supply energy to cities and industries over a wide range in Transcaucasia.

Great Britain's power generation has shown substantial increase during the first eight months of this year. During the first eight months of 1934, total electricity generated by authorized plants was 9,731,000,000 kw.-hr., as compared with 8,336,000,000 during the same period of 1933. 1,059,000,000 kw.-hr. were generated in August, 1934, as compared with 928,000,000 during August, 1933.

Swedish Government Waterfalls Board reports a net profit for 1933 of 16,500,000 kroner, or 700,000 kroner more than the year before. The yield on the average working capital invested by the Government in 1933 amount to 5.68 per cent against 5.53 per cent for the preceding year. The total consumption of electric energy during the past year is estimated at 1,800,000,000 kw.-hr., an increase of 11.4 per cent over 1932.

Felten & Guilleaume Carlswerk A.-G., Cologne, Germany, leading German manufacturers of cable, have recently constructed what is claimed to be the heaviest electrical power cable in the world, according to the Department of Commerce. The cable, constructed for a Dutch concern for use at a Rhine River crossing near Nymwegen, consists of 6,500 meters of land cable and 6,000 meters of water cable, the former weighing 36.5 kgs. per meter, the latter 52.5.

B. C. Electric Railway Builds Temporary Power Plant

Erection of a temporary power plant to serve the Bridge River mining area has now been completed by the British Columbia Electric Railway Co. The feature of this plant is that while it develops only 4,600 hp. it utilizes a tunnel costing $1,700,000 planned as the first step in an ultimate 600,000-hp. development. The tunnel was bored in 1928 to 1933, but when it was completed depression was in full swing. Since the recent development of this area into the Bridge River gold mining area, however, considerable local demand for power has been created.

The tunnel connects Bridge River with Seton Lake and is 14 ft. 3 in. in diameter, lined with concrete. It is being used both as conduit and regulating forebay. Water is brought from the river to the tunnel by canal sunk so that the water flows into the tunnel by gravity during eight months of the year. During the remaining months water is pumped into the tunnel by two 18-in., 30-c.f.s. screw pumps directly connected to 40-hp. motors. Maximum pumping head will not exceed 10 ft. The penstock is welded to a steel bulkhead installed at the outlet end of the tunnel. The 2-ft. diameter penstock is of arc-welded plates, is 2,700 ft. long, and designed to withstand a normal working pressure of 500 lb. per sq.in. at its lower end. The generating unit was moved from Jordan River power plant of B. C. Electric, where larger and more modern units have been installed. It is a horizontal, single, overhung, tangential-impulse wheel, operating under 1,200-ft. head and directly connected to a 2,300-volt generator. The power house is of temporary construction on concrete foundations, with concrete tailrace emptying into Seton Lake.

Temporary 4,600-hp. Bridge River Station of B. C. Electric Ry. Co., using $1,700,000 penstock and tunnel built for a later permanent plant

WESTERN POWER

Loup River Public Power District, 2315 Thirteenth St., Columbus, Neb., Harold Kramer, secretary, is taking bids for initial construction work on irrigation and hydro-electric power project. Bids will soon be asked for power features, including generating plant on Columbus-Genoa-Loup River power canal, in vicinity of Genoa, construction of transmission lines about 225 mi. long, power substations, switching stations and other structures. Fund of $7,300,000 has been secured through Federal aid. Harza Engrg. Co., 20 North Wacker Drive, Chicago, Ill., consulting engineer.

Northern B. C. Power Co., is planning rehabilitation of its diesel plant at Stewart, B. C., and will move it to tidewater. This work will be completed in about six weeks and will cost $65,000. An additional diesel is to be installed at a cost of $30,000. Installation of a $15,000 unit at Portland Creek and a $30,000 unit at Barney's Gulch are planned.

Winnipeg, Manitoba, has a central heating plant (Winnipeg Heating Co.) which now supplies 7,500 houses.

German Diesel Engines

Increasing popularity of diesel engines in Germany has served to buoy up production there. One Cologne manufacturer is now operating at 70 per cent of capacity. Sales abroad in the first six months of 1934 amounted to 2,297 engines having a value of 8,271,000 reichsmarks, as compared with 2,119 engines worth 8,492,000 reichsmarks last year.

AMONG THE SOCIETIES

American Gas Association held its 16th annual convention and exhibition at Atlantic City, N. J., Oct. 29-Nov. 2. Included in the extensive program were these papers of interest to power engineers: "Silica Gel and its Uses in Conditioning Air and Gases for Industrial Processing," "Effective Saving of Gas Fuel by Use of Insulation Refractory Materials," "Instances of Unusual Applications of Gas Fuel," "Review of Work on Pipe Coatings and Corrosion for 1934."

A.S.M.E. has decided to publish, in four quarterly issues beginning in 1935, a "Journal of Applied Mechanics." This journal will contain papers on the subject, supplemented by reviews of pertinent literature and notes on important developments. The editorial board will consist of specialists in the various fields.

American Society of Safety Engineers is planning a Speakers Bureau for its metropolitan section, which will include 50 safety experts who will talk upon request before interested groups. Its office is at 29 West 39th St., New York.

A.S.T.M. has accepted for publication as tentative two specifications covering (a) Alloy-Steel Castings for Valves, Flanges and Fittings and (b) Seamless Alloy Steel Pipe, the materials being for service at temperatures from 750 to 100 deg. F. The first specification includes eight classes of materials, the second includes twelve. Revisions have also been accepted as tentative in the standards for alloy-steel bolting material and pipe flanges for high-temperature service. Tentative specifications have been approved for classifying coal by rank and grade. Work is to be done on determining slacking properties of coal and accuracy of various sampling methods.

One session of the 35th annual convention of the International Acetylene Assn. will be devoted to pipe welding and testing. The meeting, to be held at Wm. Penn Hotel, Pittsburgh, on the afternoon of Nov. 15, will include these papers: "Welds for High Tensile Strength," by John J. Crowe, chief research engineer, Air Reduction Co., Inc.; "Dependability of Commercial Methods of Testing Welds," by James W. Owens, director National Weld Testing Bureau; "Production Methods Used on Welding for Construction Purposes," by G. E. Deatherage, genl. supt. of construction and J. B. Latterner, chief of planning dept., Carbide & Carbon Chemicals Corp.; "Pipe Welding," by John Zink, vice-president and chairman of welding committee, Heating, Piping & Air Conditioning Contractors Assn.

English practice in heating and ventilating was among the subjects discussed at the first 1934-35 meeting of the New York chapter, A.S.H.V.E. Oct. 15.

Joseph N. Russell, managing director of Rosser & Russell, Ltd., England, who is touring the United States studying American practice, briefly reviewed some of the outstanding differences between heating engineers in that country and in this. His firm, which has been in business for 125 years, is engaged in both engineering and contracting, and recently completed the heating and ventilating installation in the Bank of England. Mr. Russell pointed out that whereas in this country we design for temperature differences of 70 deg., in his country the maximum temperature difference is 35 deg. The smaller maximum load enables them to use 2- and 3-column radiators, as compared with our 5- and 6-column. Furthermore, due to the large number of open fires burning soft coal, the soot content of the air is extremely high, and this, coupled with the high humidity, blackens the walls near the radiators and grilles so that they must be cleaned every season.

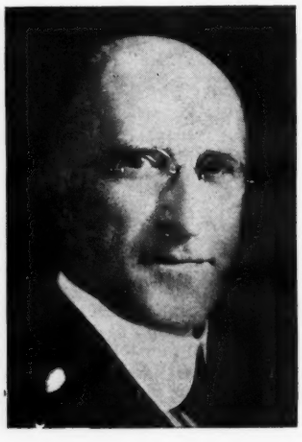
Federation of Architects, Engineers, Chemists & Technicians, with offices at 232 Seventh Ave., New York City, has announced the establishment of 70 provinsional secretaries in widely separated parts of the country to assist in building up its membership. The Federation has been represented in Washington by several committees acting as delegates in connection with the pending codes of the N.R.A.

Oil-Field Gas Engine Bearings

An operator in the Pennsylvania Bradford field, using 75 gas engines of various sizes and ages, recently reported that 1,150 lb. of bearing metal were used in maintaining 60 plain-bearing engines over a 6-mo. period. All engines run 24 hr. a day, with occasional overloads, and require new bearings at least every two years. Best-grade bearing metal is used, ranging in price from $0.58 to $0.65 per lb. Replacement of main bearings takes from 16 to 24 hr. This operator also has 15 engines equipped with Timken roller bearings, and according to his report these engines have run over five years without bearing failures.

OBITUARIES

Dr. Calvin Winsor Rice, 65, widely known engineer and for the last 28 years secretary of the A.S.M.E., died Oct. 2, in New York, after being taken suddenly ill. He joined Thomson-Houston Electric Co. in 1889, and four years later became electrical engineer for the General Electric. After several other positions, he became chief of meter testing for New York Edison, and in 1904, became consulting engineer for General Electric. It was this background of wide experience in steam, electrical and hydraulic engineering that served him in good stead when in 1906 he became secretary of the A.S.M.E. Dr. Rice was active in the establishment of the John Fritz medal, and also in the building of the Engineering Societies Building in New York.



James P. Roe, 74, director of research and engineering of Reading Iron Co., Reading, Pa., died Sept. 14. He first came to this country in 1883.

Daniel Bradford Badger, 84, chairman of the board of E. B. Badger & Sons Co., Boston, died at his home at Winchester, Mass., Oct. 3. He had been with the company for almost 70 years.

Franklin M. Bowman, 65, vice-president of Blaw-Knox Co., Pittsburgh, Pa., died suddenly Oct. 12 in Pittsburgh. He had been with the company since 1912, lately in charge of the transmission tower and structural steel divisions.

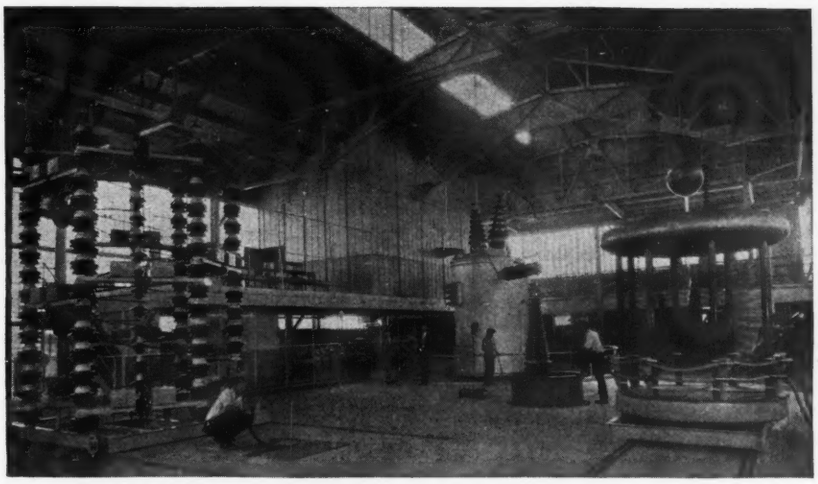
William P. White, 49, manager of the customer division of the central station department of General Electric Co., died suddenly Sept. 22 at his home in Schenectady. He had been associated with the General Electric Company for the last 28 years, and because of the nature of his work was exceptionally well-known throughout the electrical manufacturing and power company circles.

Frank Julian Sprague, 77, builder of the first successful electric railway in the United States and known as the "Father of Electric Traction," died Oct. 25 at his home in New York. He was also a pioneer in the electric elevator field, and as early as 1880 attempted to introduce incandescent lighting in the United States Navy. A graduate of the Naval Academy, he resigned from the navy in 1883 to join Thomas A. Edison. A year later he organized Sprague Electric Railway Motor Co., to develop his constant-speed electric motor and to be the first to engage in general manufacture of industrial electric motors. His company was absorbed into Edison General Electric Co. in 1890. He developed high-speed and house automatic electric elevators, the method of operating two elevators on the same rail in a common shaft, as well as an acceleration control and car safety devices. Honored in many countries and by many societies and institutions, Mr. Sprague was to have received the John Fritz gold medal for 1935 at the annual convention of the A.I.E.E. next January. The Institute last January unveiled a bronze bust in his honor.

F. W. Paterson, assistant to H. V. Erben, manager of the Switchgear Sales Div., General Electric Co., at Philadelphia, died at his home in Swarthmore, Pa., Oct. 24. He had been with G.E. since 1903.

Fulham Dedicated

Fulham Power Station, Borough of Fulham, England, had its cornerstone laid recently. Steelwork is already in place for this huge plant.



NEW HIGH IN HIGH-VOLTAGES

New equipment makes possible, by means of a helically arranged generator, indoor impulse tests up to 2,000,000 volts, outdoor tests up to 3,000,000 volts, on characteristic line structures in this new laboratory of Ohio Brass Co. at Barberton, Ohio. Indoor tests can also be made up to 1,250,000 volts at commercial frequencies of 25, 50 and 60 cycles by cascade connection of the first ten units of the three 750,000-volt transformers which in combination permit the high-voltage tests outdoors. A third element is a 750,000-volt, high-frequency generator permitting insulation studies at 50,000 to 100,000 cycles.

BUSINESS NOTES

Chicago Pneumatic Tool Co., 6 East 44th St., New York, N. Y., has moved its Birmingham, Ala., office from 1829 to 31 South Second Ave., to 211 South 20th St. W. S. Lynch continues as manager.

Parry Engrg. Co. has moved its offices to 154 Nassau St., New York, N. Y.

Consolidated Products Co., Inc., has altered and enlarged its office space on the 20th floor of 14-17 Park Row, New York, N. Y., as a result of increased demand for used machinery.

Shepard Niles Crane & Hoist Corp. has concentrated all manufacturing divisions at Montour Falls, N. Y. The Niles plant in Philadelphia has been closed and its equipment moved to Montour Falls. The plant formerly occupied by Cronk & Carrier Mfg. Co., which adjoins the Shepard plant, has been purchased, and all engineering data, fixtures and tools formerly used by General Electric in building Shepard motors have been purchased.

Joseph C. Rah & Co., 5745 W. Ohio St., Chicago, Ill., has been organized to provide a specialized engineering service for manufacturers on materials and process engineering, electrical insulation design, mechanical and electrical design, styling, chemical engineering, research, development and special problems.

Eagle Picher Sales Co., wholly owned subsidiary of Eagle Picher Lead Co., Cincinnati, Ohio, took over sales and distribution of products manufactured by Eagle Picher Lead. The same sales personnel is continued, with officers: President, A. E. Bendelari, and vice-presidents, Frederick Hertenstein, F. W. Potts, W. E. Maston, John R. MacGregor and R. M. Roosevelt; secretary-treasurer, Joseph Hummel, Jr.; assistant treasurer, C. A. Geist.

Gears & Forgings, Inc., Cleveland, which has been in receivership since April 1, 1932, has been reorganized under the name of Ohio Forge & Machine Corp. This new company will operate the former Ohio Forge and Van Dorn Dutton Divisions of Gears & Forgings and will be headed by E. H. Chaplin, president of National Acme Co. as chairman of the board, S. C. Dalbey and J. M. Clem, who formerly operated Ohio Forge Co. before the merger of Gears & Forgings as president and vice-president. The new company will manufacture all types of gearings, power transmission equipment, and the former standard line of speed reducers.

Super Oil Co. has been sold to Wayco Refining Co., 409 Griswold St., Detroit, Mich., which is now operating the refinery at the same address. A. G. Schlee is general manager of Wayco Refining and J. J. Curran superintendent.

Foster Engrg. Co., 109 Monroe St., Newark, N. J., has appointed Crawford Engrg. Co., 295 Madison Ave., New York, N. Y., as agents in New York, Long Island and Westchester. Henry J. Fortier, formerly New York representative of Foster, will now represent the company in North Jersey.

Tube-Turns, Inc., 425 Fifth St., Louisville, Ky., has moved its New York office from 30 Church St. to 110 East 42nd St., Bowery Savings Bank Bldg. W. P. Curley continues in charge.

American Diesel Engine Co. has moved its offices to 18th and Alabama Sts., San Francisco, Calif.

Control Corp. of America, formed and headed by F. W. Warren, will market Chrysler-made equipment for cooling, heating and ventilating theatres in the United States. Andre Merle, author of several recent articles in *Power* on refrigeration and air conditioning, will be head of Mr. Warren's engineering staff.

Louis Allis Co., Milwaukee, Wis., has opened a branch in Atlanta, Ga., in the Bona Allen Bldg. Local sales offices and service stations will be under supervision of this office. George C. Gardner is in charge.

Combustion Engineering Co., Inc., 200 Madison Ave., New York, N. Y., has divided its southern territory into two districts. The Southeastern district will extend from Richmond to Florida with headquarters at Charlotte, N. C., and T. C. Heyward as district manager. The Southwestern district extending south of the Kentucky-Tennessee border and west of Atlanta to the Mississippi River, will be under the Chattanooga district office, with L. C. Haller as district manager. E. L. Shuff, formerly in charge of the Atlanta office, has been made district manager in Cincinnati.

Bryant Heater Co., Cleveland, Ohio, has acquired exclusive rights to Silica Gel and all Silica Gel equipment patents for air conditioning. These are largely for dehumidification of air, the system working on the principle that a greater reduction in humidity makes necessary a correspondingly smaller reduction in temperature, thus avoiding any sensation of dampness or chill resulting from refrigeration. Unit conditioners and central plants utilizing the process are being developed.

Fabreeka Belting Co. has changed its name to Fabreeka Products Co. and is moving its offices to 77 Franklin St., Boston, Mass. Officers are: Philip W. Wrenn, president; John S. Goodman, treasurer; and Wm. S. Brennan, vice-president.

Skinner Engine Co., Erie, Pa., has appointed George F. Wolf as manager of its Chicago office, 20 North Wacker Drive, to succeed the late W. T. Greenleaf, who died earlier this year. Mr. Wolf has for the past several years been manager of the company's Cleveland office.

Prat-Daniel Corp. has moved its plant from New Rochelle, N. Y., to larger facilities in Port Chester, and will also have its general and engineering office at this plant. Sales office will remain in the Empire State Building, New York, N. Y.

Hydro-Ash Corp. has moved to 53 W. Jackson Blvd., Chicago, Ill., and has secured U. S. rights for the Leach powdered coal burner.

Foster Engineering Co., Newark, N. J., and Sarco Co., New York, N. Y., have joined the Exhibitors Advisory Council, New York, N. Y., a fact-finding organization which issues data on industrial and trade shows and expositions.

Homestead Valve Mfg. Co., Coraopolis, Pa., has appointed these representatives: Grinnell Co., 240 Worth Highland Ave., Atlanta, Ga.; L. E. Livingston, 2012 Ward Pkwy., Fort Worth, Texas; and National Supply Co., Toledo, Ohio. New representatives for the Hypressure Jenny vapor spray cleaning machine include: South Side Body Co., Inc., 109 W. Morris St., Indianapolis, Ind.; L. E. Livingston, 2012 Ward Pkwy., Fort

Worth, Texas; Wm. H. Ziegler Co., 2331 University Ave., S.E., Minneapolis, Minn.; Brogan & Co., 810 Race St., Philadelphia, Pa.; Beckwith Machinery Co., 6550 Hamilton Ave., Pittsburgh, Pa.; James A. Hall, 110 Byrne St., Houston, Texas; Boehck Equipment Co., 2404 W. Claybourn St., Milwaukee, Wis.

L. D. Wyant, 800 South Main St., Tulsa, Okla., has been appointed Oklahoma state representative for Kieley & Mueller, Inc., New York, N. Y.

Municipal Electric Service Corp. of Indiana has taken out a charter to construct and operate electric light and power plants and distribution systems for municipalities. Offices are in the Merchants National Bank Bldg., Indianapolis, Ind., and Chicago offices at 236 N. Clark St. Incorporators are F. W. Douglas, A. R. Urion, W. E. Carson, P. J. Minck, and M. R. Minck.

Kingston-Conley Electric Co., 66 York St., Jersey City, N. J., has been formed by F. Kingston and B. L. Conley to manufacture fractional-horsepower, heavy-duty motors. Mr. Kingston was formerly superintendent of the small-motor department of Crocker-Wheeler at Ampere, N. J., and Mr. Conley was formerly electrical engineer with the Hoover Co., North Canton, Ohio.

Cummins Engine Co., Columbus, Ind., has appointed Cummins Diesel Engine Corp., of New York, with offices at 51 East 42nd St., New York, N. Y., as distributor for the Middle Atlantic and New England states. Elmer G. Griese, formerly Cummins sales representative for many years, heads the new independent corporation.

National Valve & Mfg. Co., Pittsburgh, Pa., has appointed Abramson Corp., 481 Winspear Ave., Buffalo, N. Y., representative in Central and Western New York. Offices will be maintained in Buffalo and Rochester, with representation in smaller towns.

Walter N. Chargill, 185 Devonshire St., Boston, sales agent for Air Preheater Corp., has now been appointed by The Superheater Co., New York, as its sales agent in the New England states.

Falk Corporation, Milwaukee, Wis., has appointed T. F. Scannell, formerly St. Louis representative for the Dallas-Texas territory, with offices at 1410 Magnolia Building. Fitch S. Bosworth, 5457 Cabanne Ave., St. Louis, has taken over the St. Louis territory.

Lewis Air Conditioners, Inc., Minneapolis, Minn., has granted Detroit Lubricator Co., Detroit, Mich., a license under Patent No. 1,785,741 on "Air Conditioning System."

Crew-Taylor Engineering Corp. has moved its offices and factory to 305 East 45th St., New York City.

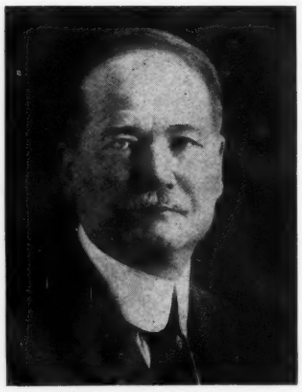
Louis Allis Co., Milwaukee, has appointed Wallace I. Cousins representative in Delaware and the District of Columbia, with offices at 4402 Kathland Ave., Baltimore.

Ideal Commutator Dresser Co., Sycamore, Ill., has moved its Chicago office to 618 West Lake St., in charge of S. S. Callner, commutation engineer.

Raymond Bros. Impact Pulverizer Co., Chicago, has organized a metallurgical division to supply a line of coal pulverizers, transportating and burning equipment, to be under direction of C. F. Herington as manager

Harnischfeger Corp., Milwaukee, is this year celebrating its 50th anniversary. In celebration, the company has published an attractive anniversary booklet, entitled "The Fiftieth Year" bound in gold and purple and illustrated throughout its 84 pages. It tells the story of the pioneers, Henry Harnischfeger and Alonzo Pawling, and the company they developed.

PERSONALS



Bert Houghton, operating superintendent of Brooklyn Edison Co. for more than 22 years, retired as of Oct. 10. Mr. Houghton, before he came to Brooklyn Edison in 1912, was with Boston Electric Light and later with Boston Edison Co. on design and installation of generating plants and sub-stations. He was also at various times employed by E. D. Leavitte, consulting engineer, and later by General Electric and Lockwood Greene Co. Mr. Houghton's successor is E. C. M. Stahl, formerly assistant operating superintendent, who has been with Brooklyn Edison for the past 12 years, first as electrical field engineer, then later as assistant superintendent of the Hudson Avenue station and engineer of tests. He has been assistant operating superintendent since 1930.

Roger W. Andrews, until lately assistant to the president of Blaw-Knox Co., has been placed in charge of the new Western Division of the sales organization of Combustion Engineering Co., New York. Under the direction of the H. S. Colby, general sales manager, the new Western Division will comprise the Detroit, Chicago, Indianapolis, St. Louis, Kansas City, Houston, Tulsa, Minneapolis and Denver offices. Mr. Andrews has been connected with the steam power field since 1910 when he joined Northern Equipment Co., finally to become secretary and general sales manager. In 1914 he formed R. W. Andrews Co. of Chicago, handling power plant equipment and a year later, formed Andrews-Bradshaw, which developed in the early twenties in connection with Tracy Engineering Co. certain specialized boiler room equipment. This company merged with Blaw-Knox in 1928.

C. J. Gaskell, partner in Hoshall Machinery Co., Memphis, Tenn., for the past eight years, has opened his own office under the name of C. J. Gaskell Co. in that city.

E. F. LeNoir, formerly president of Union Electric Mfg. Co., has been appointed representative for Louis Allis Co., Milwaukee, with headquarters at Allentown, Pa.

Karl B. McEachron, lightning research engineer at the Pittsfield-Massachusetts Works of General Electric Co., has been promoted to be engineer in charge of high voltage practice throughout the works. He will direct the activities of the high-volage engineering laboratory, formerly in charge of the late F. W. Peek, and will correlate all lightning research work being carried on various designing engineers.

John Arms has been elected secretary of United Engineering Trustees, Inc., to succeed Alfred D. Flinn. This is the holding company for the Engineering Societies Building and the Engineering Societies Library. Mr. Arms, a member of the A.S.M.E., was formerly general manager of the corporation, a position which he will continue to occupy.

Michael C. O'Neill has been appointed director of the state division of smoke inspection in the Massachusetts Department of Public Utilities at a salary of $5,000 per year by Governor Ely. He is a former mayor of Everett, Mass., and succeeds to the post held by David A. Chapman at the time the 1933 Legislature cut down the division, curtailing its activities to include a very limited section of the commission's organization. The division was re-created by this year's Legislature, but jurisdiction over plant designs and remodeling of heating installations was omitted from the revived set-up.

R. X. Raymond, associated with the company or more than 14 years, has been appointed manager of its Minneapolis district by Chain Belt Co., Milwaukee. He will succeed G. A. Gunther, who becomes district manager in Detroit. The Minneapolis office is at 808 La Salle Ave.; the Detrot office at 5169 Martin Ave.

Victor G. Vaughn, formerly manager of the Appliance Engineering Division of Westinghouse, has joined Spencer Thermostat Co., Attleboro, Mass., where he has charge of all operations.

W. R. Judson has been appointed manager of the Salt Lake City district office, Kearns Bldg., Salt Lake City, of Allis-Chalmers Mfg. Co., Milwaukee. He was formerly managing director of Allis-Chalmers (France).

Otto Nonnenbruch, New England sales representative of De La Vergne Engine Co., Philadelphia, for diesels and refrigeration, has been transferred to the New York office at 120 Broadway. He will represent the company in both New York and New England.

Sir Harry McGowan, K.B.E., chairman of Imperial Chemical Industries, Ltd., has been chosen president of the Institute of Fuel (Great Britain) because of inability of Sir John Cadman, K.C.M.G., D.Sc., to serve until next year due to absence on business.

Dr. Hermann von Schrenk, consulting timber engineer, St. Louis, and senior vice-president of the American Society for Testing Materials, has been elected president to succeed W. H. Bassett, who died July 21, soon after he took office as head of the society. H. S. Vassar has been appointed senior vice-president, and A. C. Fieldner, chief engineer, Experiment Station Division, U. S. Bureau of Mines, has been elected junior vice-president.

Rolf S. Julsrud has been appointed fuel engineer for Stephens Fuel Co., Inc., 220 East 138th St., New York. N. Y. He was formerly associated with Combustion Engineering Corp. and the Anthracite Institute in steam and fuel engineering work.

Frank J. Johnson has resigned as president of American Hoist & Derrick Co., St. Paul, Minn. He was one of the founders of the company. Frederick Crosby, son of the other founder, succeeds Mr. Johnson. Howard S. Johnson, son of Frank J., retains his title as vice-president, and Harold O. Washburn, formerly superintendent, has been appointed vice-president and treasurer to succeed Mr. Crosby.

Harry H. Hustedt, Commercial Terminal Warehouse Co., 400 N. Peter St., New Orleans, La., has been appointed distributor at New Orleans for Plibrico Jointless Firebrick Co., 1800 Kingsbury St., Chicago, Ill.

William B. Stout, designing engineer and executive of Detroit, has been nominated as president of the Society of Automotive Engineers for the year 1935.

George S. Rickenbach will take over representation in Cleveland for Dearborn Chemical Co., Chicago, Ill., following the death of E. H. Ruhlman, who died April 14, after representing Dearborn in Cleveland for 29 years. The southern part of Mr. Ruhlman's former territory will be handled by C. C. Brown.

William E. S. Dyer, consulting engineer of Philadelphia, has been appointed president of Edge Moor Iron Co., Edge Moor, Del., effective Sept. 25. Mr. Dyer has been a consultant for almost 30 years in the design, construction and operation of high-efficiency power plants.

Henry D. Bevan has been appointed manager of the Philadelphia district office, at 1109 Otis Bldg., 16th and Sansom Sts., for Terry Steam Turbine Co., Hartford, Conn. Mr. Bevan was formerly assistant manager of the New York office.

Raymond A. Hopkins has been appointed engineer in charge of hydroelectric station design for the Tennessee Valley Authority. He is making his headquarters at Knoxville, Tenn., and was formerly a member of the consulting engineering firm of Hopkins & Gove, Waltham, Mass. For 22 years Mr. Hopkins was connected with the Stone & Webster Engineering Corp., Boston, as an electrical engineer and was in charge of many important electrical projects including the electrification of the anthracite coal breaker of the Philadelphia Coal & Iron Co. at Locust Summit, Pa., and other installations.

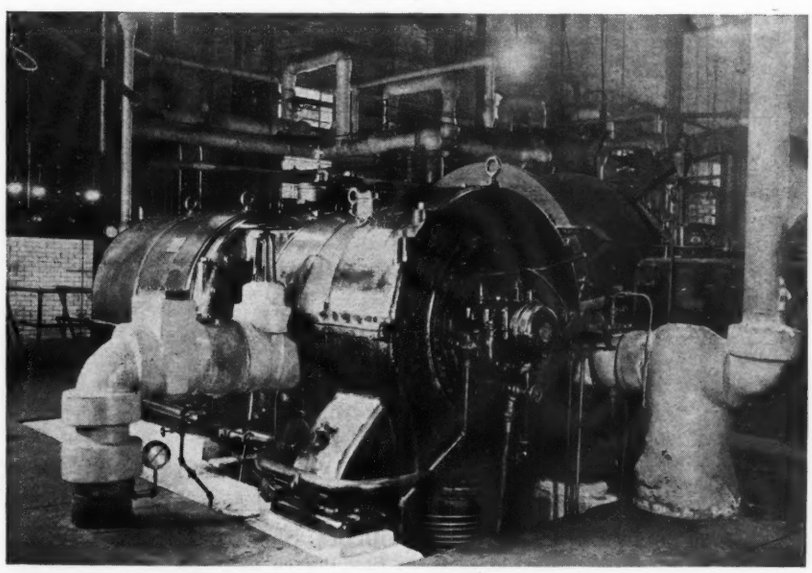
STRAWS

Pointing the way business winds blow

Norris Dam, under construction near Knoxville, Tenn., on the Clinch River, will be completed within 20 months, according to David E. Lilienthal, member of T.V.A.

Procurement Division, Treasury Department, Public Works Branch, Washington, D. C., will receive bids until Nov. 13 for engine-generator set for power house at National Home for Lepers, Carville, La.

La Salle, Colo., has voted $42,000 bonds for new municipal electric light and power plant and plans early call for bids for diesel engine-generator unit and accessory equipment.



19-YR. TURBINE HAS MADE 34 BILLION REVOLUTIONS

This 1,250-kw., 450-volt, G.E. turbine-generator has been whirling away at 3,600 r.p.m. on an almost uninterrupted 24-hr. schedule since it was installed in Armour & Co.'s Union Stockyards power plant in 1916. Two stops for reblading and nineteen for annual inspections are all that have interrupted its more than 34 billion revolutions.

Alexandria, La., has plans nearing completion and soon takes bids for extensions and improvements in municipal electric light and power plant, including installation of new prime movers and auxiliary equipment. Fund of $250,000 has been arranged. I. W. Sylvester, city engineer, in charge.

Amalgamated Sugar Co., Ogden, Utah, plans construction of a steam power plant for processing, central steam heating and other operating service at proposed new beet sugar mill on 75-acre tract near Clarksburg, Yolo County. New mill will consist of a group of about 15 buildings. Machinery for most part will be electric-operated. Complete project will cost in excess of $1,000,000. A. J. Forbes chief engineer.

Seattle Board of Public Works, Geo. W. Roberge, secretary, County City Building, taking bids until Nov. 8 for furnishing control and instrument switchboards, frequency and load control equipment for Diablo powerhouse to be constructed below Diablo dam on the Skagit River, Washington. Materials estimated to cost between $35,000 and $45,000.

Alta Electrical & Mechanical Co., Inc., 467 O'Farrell St., San Francisco, Calif., has been awarded contract by Bureau of Yards and Docks, Washington, D. C., for two new power substations and electrical distribution system at Government Navy Yard, Pearl Harbor, T. H., at $378,850. Work will include installation of motor-generator sets with automatic control, transformers and accessories, new underground feeder system for primary and secondary a.c. lines, new underground d.c. feeder system, series lighting system and miscellaneous work.

Culpeper, Va., dedicated its municipal power plant Oct. 19. This is the first municipal plant completed with PWA funds.

Two large hydro-electric power projects are maturing in South Carolina, to be carried out through Federal financing. Greenwood County Board of Commissioners, Greenwood, has made formal application to the Federal Power Commission for permission to construct and operate a hydro-electric generating plant on the Saluda River, for which a Federal allotment of $2,767,000 recently was approved. Work has begun on clearing an area of about 18 sq.mi. for a lake and power dam, with a short line totaling 300 mi. Site selected for generating station is Buzzard's Roost. As soon as Federal permission has been secured, bids will be asked by Chief Engineer Duncan, Greenwood. The second development will be carried out in the Southeastern part of the State by the Santee-Cooper Authority, of which Mayor Burnet Maybank, Charleston, is chairman. Plans by Foundation Co., and Murray & Flood, consulting engineers, both of New York, N. Y., including estimates of cost. It is proposed to construct a hydro-electric generating plant on the Santee River, near Pinopolis, S. C., with initial capacity of 200,000-hp.

Iowa City, Ia., has been petitioned by Iowa City Municipal Ownership League to proceed at earliest possible date with construction of proposed municipal electric light and power plant, which project was approved at a special election a few months ago. Financing for $917,000 is being arranged through Federal aid. Walter E. Schwab, Iowa City, consulting engineer.

PWA Administrator Ickes has clarified that body's policy on municipal plants. He explains that PWA funds are available only for projects which will result in definite rate reductions over the lowest that can be granted by public utilities now serving the areas in question. Where the utility meets the lower rate schedule of the proposed municipal plants, PWA funds are not forthcoming. Under this ruling, Columbus, Ohio, has been asked to withdraw its request for aid.

Seattle Board of Public Works has granted the request of J. D. Ross, superintendent of lighting, to employ C. E. Webb, district engineer for Dominion Water Power & Hydrometric Bureau, Vancouver, B. C., to build a stream-gaging station near the Canadian border at a cost of $2,000.

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has secured contract from Water & Power Bureau, Los Angeles, Calif., for seven 65,000-kva. electric transformers, largest type now produced, and complete accessory equipment, for terminal power substation at Los Angeles of 287,000-volt power transmission line now being built from Boulder Dam hydro-electric power plant of Government at Boulder Dam, on California-Arizona-Nevada state lines, to city, a distance of about 285 mi. Each transformer will stand about 35 ft. high and will weigh 225 tons; units will step-down the high incoming voltage to 132,000-volt for main feeder lines in municipal zone. Contract totals approximately $1,000,000, and is said to be the largest single order for such type equipment placed in the last five years. Construction will be carried out at Sharon, Pa., Westinghouse plant. Another contract has been received by Westinghouse for all electrical equipment for new 10,000-ton floating dry dock of Tampa Shipbuilding & Engrg. Co., Tampa, Fla.

Bureau of Power & Light, Los Angeles, Calif., has awarded a $140,889 contract to the Delta-Star Electric Co. of Calif., Los Angeles, covering sixteen 287,000-volt, 1,200-amp. 3-pole motor-operated disconnecting switches for installation on the 275,000-volt, double-circuit transmission line connecting Los Angeles with Boulder Dam. These will be the largest disconnectors yet produced in this country.

Ohio municipalities have plans maturing for electric light and power projects. Clyde is arranging a bond issue of $60,000 for additions and betterments in present station, including installation of new equipment. East Liverpool is projecting plans for a new municipal power plant for light and power service, reported to cost over $400,000, and proposes to vote bonds in near future. East Palestine will make extensions and improvements in electric power plant, and soon takes bids for new boiler and other equipment, entire program to cost about $30,000. Cleveland has plans nearing completion for repairs and improvements in municipal electric light and power plant at East Fifty-third St. and Lake Front, to include installation of considerable new equipment, project to total about $250,000.

Burlington, Kan., plans early construction of new municipal electric light and power plant, and electrical distribution lines. Fund of $145,000 being arranged. E. T. Archer & Co., New England Bldg., Kansas City, Mo., consulting engineers.

Singer Bldg., New York, N. Y., is adding a 750-hp. Winton diesel to its steam plant to improve heat balance. Diesel jacket water will heat boiler feedwater by means of a heat exchanger, then steam-engine exhaust will raise feedwater temperature still further in an open heater, and final raising to the boiling point will be done in a waste-heat boiler using diesel exhaust gases.

Estherville, Iowa, has purchased a 750-hp. Worthington diesel for its 1,350-hp. plant.

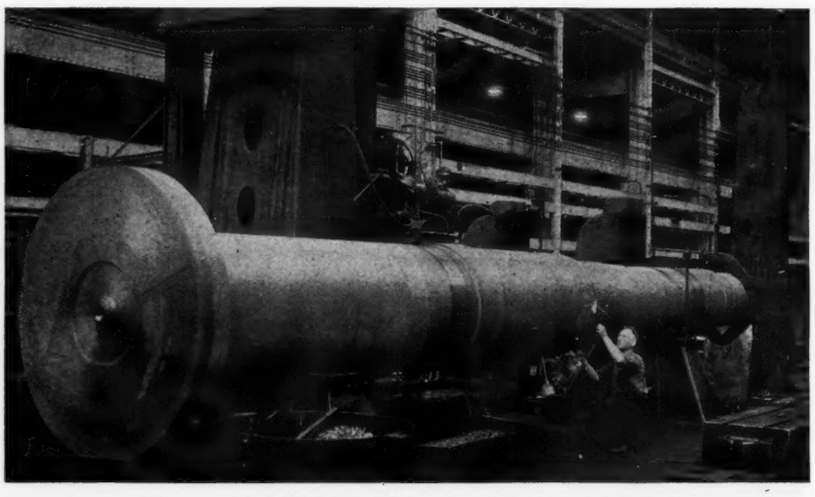
Jacksonville, Fla., is considering a report, submitted by Taylor Engrg. Co., Jacksonville, consulting engineer, recommending extensions and improvements in municipal electric light and power plant, including installation of new prime movers and other equipment. Work estimated to cost about $430,000.

Grand Coulee Dam should be constructed immediately, in the opinion of Dr. Elwood Mead, federal commissioner of reclamation. He believes that immediate construction of the $170,000,000 high dam would supply power and water for irrigation to immigrants from drouth-stricken states.

TVA has proposed an unbiased investigation of the respective costs of water power and coal energy, in response to criticism by the coal industry.

Menominee, Mich., plans call for bids in near future for equipment for new municipal electric light and power plant, for which financing in amount of $803,000 has been arranged through Federal aid. The city will issue bonds for $623,000 at once. Francis Engrg. Co., Saginaw, Mich., consulting engineer.

White River Power Co. is proposing a series of three dams with an ultimate capacity of 159,000 hp., all to be built on the White River, Ark. One dam would be at Wildcat Shoals, five miles



MACHINING SHAFT FOR BOULDER DAM GENERATOR

One of the heaviest to be machined at the East Pittsburgh Works of Westinghouse, this shaft for one of the Boulder Dam generators weighs 106,000 lb., is 392 in. long, 38 in. body diameter, and 64¾ in. flange diameter. For inspection purposes, the shaft was drilled through, end to end, with a 6-in. drill. This hole, reamed and polished, would expose the slightest flaw in the core affecting the strength of the shaft. Here a milling machine is cutting a keyway in the shaft. The generators will be of the vertical waterwheel type, having a capacity of 82,500 kva. each, the largest of their type to be built.

above Carter, Ark., a second at Bull Shoals, and a third at Hog Thief Bend. The first would be 83 ft. high and develop 68,000 hp. Construction of the dam would create a lake 40 miles long with a reservoir volume of 208,000 acre ft. The second unit at Bull Shoals would be 75 ft. high and would develop 61,000 hp. creating a 43-mile lake with volume at 300,000 acre ft. The Hog Thief Bend dam would be 68 ft. high and develop 25,000 hp., creating a 40-mile lake with a reservoir volume of 104,000 ft. A license has been applied for.

Rath Packing Co., Waterloo, Ia., is constructing an extension to its power station, with Stone & Webster Engineering Corp. designing and supervising the work. The extension comprises a 35,000-lb. per hr. boiler operating at 440 lb. pressure and a 625-kw. non-condensing turbine-generator to produce byproduct electric power. Steam will be extracted from the turbine at 125 lb. pressure and exhausted at 45 lb. pressure, for plant processes. The balance of the plant's electric power requirements will continue to be purchased from Iowa Public Service Co. Steam extracted and exhausted from the turbine generator will be supplemented by supply at 125 lb. pressure from the 4 existing boilers (capacity totaling 96,000 lb. per hr.). Cost will be about $182,000, including a new reinforced concrete stack about 200 ft. high and approximately 10 ft. inside diameter.

Emporia, Kan., has plans maturing for new municipal gas distribution system, with main trunk lines for feeder service, totaling about 90 mi., estimated to cost close to $1,000,000, including distributing station. Bond issue of $345,000 will soon be voted for initial portion of project. Black & Veatch, Mutual Bldg., Kansas City, Mo., consulting engineers.

Federal Emergency Administration of Public Works, office of J. H. Johnston, state engineer, Citizens' Southern Bank Bldg., Atlanta, Ga., plans steam power house for central heating service at new state prison buildings near Reidsville, Ga., for which bids are being asked until Nov. 20. Group of one and multi-story buildings will be erected. Cost over $1,000,000. Bids for certain mechanical equipment also being received at time noted. Tucker & Howell, Rhodes-Haverty Bldg., Atlanta, architects; Newcomb & Boyd, Walton Bldg., Atlanta, mechanical and electrical engineers.

A. P. Stitzel Co., Louisville, Ky., affiliated with W. L. Weller & Sons, Starks Bldg., Louisville, distillers, plans one-story steam power plant at new distillery on Dixie Highway, near Jeffersontown, Ky., where large tract of land has been secured. Proposed to ask bids for mechanical and general equipment at early date. Cost close to $100,000. Joseph & Joseph, Breslin Bldg., Louisville, architects and engineers.

Miller Brewing Co., West State St., Milwaukee, Wis., has plans for new 1-story steam power house at brewery, 57x85 ft., estimated to cost about $40,000 with boilers, pumps and other equipment. Work is scheduled to begin at early date.

Devils Lake, N. D., has plans nearing completion for new municipal electric light and power plant, and will begin work on project in near future. A fund of about $300,000 is being arranged. Burns & McDonnell Engrg. Co., 107 West Linwood Blvd., Kansas City, Mo., consulting engineer.

Blue Grass Distilling Co., Louisville, Ky., W. L. McComas, head, recently organized, plans construction of 1-story power house at proposed new distillery at Fisherville, Ky., where site has been acquired. New plant will cost approximately $100,000.

San Poil Power & Light Co., Republic, Perry County, Wash., is planning to reconstruct its power plant, destroyed by fire Sept. 29 at an estimated loss of $90,000. Apparatus will include a 300-hp. diesel engine-generator with switchboard and accessories, and has already been purchased from Cascade Machinery & Electric Co., Seattle.

Washington Water Power Co., Spokane, Wash., will supply current for construction of the Grand Coulee Dam.

Kanawha Valley Power Co. has applied to Federal Power Commission for permit to use the head created by the government dam which will probably be built just below Winfield on the Kanawha River to operate four generating units having a total capacity of 26,000 hp. Output will be delivered to Appalachian Electric Power Co. It is believed that a P.W.A. allotment will be made for construction of the dam itself.

Noranda Power Co., Ltd., Toronto, Ont., recently organized subsidiary of Noranda Mines, Ltd., Royal Bank Bldg., Toronto, Ont., has taken over all leases and power rights held by the parent organization on the Victoria or upper Ottawa River, in vicinity of its gold-mining properties. The new power company has engaged Fred A. Gaby, Toronto, consulting engineer, formerly chief engineer for Ontario Hydro-Electric Power Commission, to prepare plans for hydro-electric generating plant. Station will have an initial installed capacity of about 20,000 hp., all used by parent company at its mines, replacing central station service. Project reported to cost in excess of $450,000.

Muskogee, Okla., is arranging for a bond issue of $1,260,000 for new municipal electric light and power plant, for which plans will be drawn in near future.

Norton Co., Worcester, Mass., has produced the hardest material ever made by man, Raymond R. Ridgway of that company's research laboratories announced before the Electrochemical Society, Sept. 27. The material is boron carbide, less hard only than diamond.

Broadway low-level vehicular tunnel between Alameda and Contra Costa Counties in California has purchased 16 giant Sturtevant fans for ventilating purposes, capable of supplying 70 tons of air per minute.

State Board of Education, Boise, Idaho, has authorized plans for a new ice-manufacturing and cold storage plant at the Idaho Industrial Training School, St. Anthony, Idaho.

Tracy, Calif., is considering construction of new electric power plant for municipal water pumping station and street-lighting system. Diesel engine-generating unit will be used. Estimates of cost have been authorized.

Norfolk, Neb., has preliminary plans under way for new municipal electric light and power plant and electrical distribution system. Estimates of cost being made by Black & Veatch, Mutual Bldg., Kansas City, Mo., consulting engineers, and authorization for call for bids will soon be issued.

Kroger Grocery & Baking Co., Cincinnati, Ohio, soon takes bids for equipment for new steam power plant on State St., including boilers, fuel pulverizers, mechanical draft apparatus and other equipment. Estimated cost close to $150,000. Tietig & Lee, 34 West Sixth St., architects; Fosdick & Hilmer, Union Trust Bldg., consulting engineers.

Kentucky Public Service Co., Elizabethtown, Ky., John N. Ashcraft, head, has secured permission to construct a new welded steel pipeline in Hardin and Barren Counties for natural gas service, totaling about 78 mi. Line will be 4-in., with about 15 mi. 6- in. pipe. Cost over $250,000.

NEW BULLETINS

Diesel Engines. De La Vergne Engine Co., Philadelphia, Pa. Five new bulletins, Nos. 51 to 55, inclusive, and No. 58, describe full line of De La Vergne diesels. Engines are all four-cycle, full-diesel, solid injection, and range from Model VL which, at 1,200 r.p.m., and with six cylinders, develops 200 hp., up to Model VB, which, with eight cylinders at 200 r.p.m., develops 1,600 hp. Detailed specifications and overall dimensions included.

Distribution Service Cutout. Schweitzer & Conrad, Inc., 4435 Ravenswood Ave., Chicago, Ill. Bulletin 215 illustrates and describes "Semafor" open and box-type cutouts, "Positect" bayonet-type cutouts, and heavy-duty inclosed Type EB cutout. Also explanation of S&C arc-interruption action and complete illustration of S&C universal fuse link usable with other than S&C cutouts of the expulsion type.

Portable Compressed Air Cleaner. Hagan Corp., Pittsburgh, Pa. 4-page bulletin, "The Hagen Portable Compressed Air Cleaner," illustrates this unit suitable for power-house use and for cleaning generators.

Variable-Speed Transmission. Reeves Pulley Co., Columbus, Ind. Novel silhouette bulletin T-6700 gives cross-section and engineering facts on this company's transmission.

Maintenance of Reciprocating Parts. Linde Air Products Co., 30 East 42nd St., New York, N. Y. Booklet, "Maintenance of Reciprocating Parts," deals with application by oxy-acetylene process of wear-resisting bronze to wearing surfaces of sliding parts.

Roller Bearings. Shafer Bearing Corp., 6501-99 West Grand Ave., Chicago, Ill. 50-page Catalog No. 12 describes self-aligning roller bearing unit. Fully indexed, list prices, engineering data.

Cable Equalizers. L'Code Corp., 419 Fourth Ave., New York, N. Y. Folder E-30, 4-page, describes elevator cable equalizers.

Traps. J. E. Swendeman, Inc., 171 Camden St., Boston, Mass. 4-page bulletin describing multi-gravity trap which will handle water, oil or any two or more liquids of varying specific gravity coming from aftercoolers, receivers, or any other apparatus.

Westinghouse. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. 4-page catalog 43-950 describes Type LE photo-relays for either a.c. or d.c. 4-page section 31-575 describes Polaricode, Jr., supervisory control. Equipped for a total of five selective complete operations. 4-page section 41-350 describes Type SG auxiliary relays, and 12-page catalog 41-505 describes Types CR and CRA directional overcurrent relays.

NEW BULLETINS

Aluminum Paint. Aluminum Industries, Inc., Cincinnati, Ohio, booklet, "Buy It by the Foot," brings latest methods of manufacturing and applying aluminum paint and illustrates the various types of jobs on which this type of paint was used.

Power Plant Accessories. Ideal Commutator Dresser Co., Sycamore, Ill. Eight-page broadside on new product for greater plant efficiency, showing small units for power-plant use from sealing liquids to electric drills and grinders.

Thermostats. Fox Engineering Co., Boston, Mass. Six-page folder on non-electric thermostatic valves for steam, gas, air and oil in automatic and remote control for temperature and pressure.

Used Machinery. Consolidated Products Co., Inc., 15 Park Row Building, New York, N. Y. Vol. 2, No. 1, dated June 1934, of "Consolidated News," gives news of the used machinery field and lists a wide variety of power and distilling equipment available secondhand.

Boilers. Babcock & Wilcox Co., 85 Liberty St., New York, N. Y. Twenty-page fully illustrated booklet on B. & W. integral-furnace boilers recently described in Power, showing operating characteristics of several installations.

Portable Compressors. Ingersoll-Rand Co., 11 Broadway, New York, N. Y. Novel 20-page bulletin, Form 2100, "A Better Portable Compressor," describes advantages of company's two-stage air portable compressor in sizes from 75 to 370 c.f.m. piston displacement.

Fairbanks-Morse. Fairbanks, Morse & Co., Chicago, Ill. Vol. 10, No. 4, of "The F-M News" commemorates the 104th Anniversary of this company and gives interesting data on the history of its scales, internal combustion engines, pumps, motors and other products.

Plug Valves. Nordstrom Valve Co., 400 Lexington, Homewood, Pittsburgh, Pa. Bulletin No. V-102 illustrates, blueprints and gives specifications of the Emco-Nordstrom valve adapted to gate valve dimensions, and in a variety of types.

Automatic Controller. Foxboro Co., Foxboro, Mass. Four-page bulletin DMF-637, describing Foxboro controllers for temperature and pressure.

Corrosion Prevention. Cumberland Engineering Co., 6 Lloyd's Ave., E.C. 3, London, England. 20-page booklet on the Cumberland electrolytic system for prevention of corrosion and scale, including a description, reports from users, illustrations of installations, etc.

Meters and Recorders. Esterline-Angus Co., Indianapolis, Ind. "Solving Industrial Crimes, Case No. 3," small 12-page booklet describing meters and recorders of various types for use in industrial and central station power plants.

Stainless-Clad Steel. Ingersoll Steel & Disc Co., 311 South Michigan Ave., Chicago, Ill. 10-page booklet, "Manual of Welding and Fabricating Procedures for IngAClad Stainless Clad Steel," takes up, step by step, various methods of welding, soldering, lock-seaming, riveting, pickling, heat-treating, etc., encountered in fabricating products of stainless-clad steel.

Molybdenum Alloys. Climax Molybdenum Co. 295 Madison Ave., New York, N. Y. "The Moly Matrix" is a series of publications having to do with molybdenum irons and steels, showing what properties molybdenum imparts to these products.

V-Belts. Manhattan Rubber Mfg. Division, Raybestos-Manhattan, Inc., Passaic, N. J. Fifty pages of pertinent engineering information and latest list prices on Condor V-belts in 1934 edition of V-Belt Engineering Data Book. Chapters on selecting V-belt drive on design of special V-belt drives, also numerous standard tables, charts and belt and sheave list.

Dust Collectors. Prat-Daniel Corp., Port Chester, N. Y. Two new bulletins, 4-page "Thermix" Multi-Cyclone Dust Collectors, giving general information and specific data on these units, and 2-page "Operating Facts, Thermix Dust Collecting Fan and Thermix Multi-Cyclone Dust Collector."

Steam Generating Sets. Troy Engine & Machine Co., Troy, Pa. 32-page bulletin 107, "Troy-Engberg Generating Sets" covers wide range of sizes, both vertical and horizontal engine-driven machines in d.c. and a.c., and for both stationary and marine service.

NEW PLANT CONSTRUCTION

McGraw-Hill Business News Department Is Prepared to Furnish a More Complete Daily Service

Ark., Osceola—City, c/o Mayor, plans for light and power plant and equipment indefinitely delayed. Bids taken on 600 hp. diesel engine but no award made, due to local complications present status of project very indefinite. P.W.A. allotted $53,000. M. C. Baumann, West Memphis, engr.

Ark., Paragould—City plans construction of municipal lighting and power plant. Supreme Court denied petition of Arkansas Utilities Co. for review of ruling against the company.

Calif., Los Angeles—U. S. Indian Irr. Service, 7515 Figueroa St., bids Nov. 13, furnishing and installing 30 turbine pumps and motors and pump houses for San Carlos Project.

Calif., Sacramento — Sacramento District and County, bond election Nov. 6, $12,000,000 for power plant and distribution system. Burns & McDonnell Eng. Co., 107 West Linwood Blvd., Kansas City, Mo., engrs.

Calif., Tracy—City Council to secure estimates of cost of substituting Diesel power for electric motors to operate pumps of municipal water plant and to generate electricity for street lighting.

Colo., Rifle—Municipality plans Diesel electric power plant. Est. $70,000. P.W.A. funds allotted. H. Thwaits, 357 Lafayette St., Denver, engr.

Ind., Linton—Antioch Power Co. plans installing 6,000 kw. electrical equipment. $46,000.

Kan., Kingman—Municipality plans Diesel engine electric power plant. $30,000.

Kan., Osawatomie—City water and Diesel engine electrical light plant. $166,000. P.W.A. withdrew loan and grant. Burns & McDonnell Eng. Co., 107 West Linwood Blvd., Kansas City, Mo., engrs.

Ky., Burkesville—City made application to State Public Service Comn. for permission to construct municipal power plnat.

Md., Baltimore—Gas & Electric Co., Lexington Bldg., plans by A. D. Loizeaux, c/o owners, 2 story, 60x80 ft., brick, concrete electric substation. To exceed $30,000 with equipment.

Mass., Worcester—Crompton & Knowles Co., 93 Grand St., plans by F. J. Sill, East Main St., Westboro, power plant alterations and improvements, Grand St. Est. $28,500.

Mich., Greenville — Municipality plans light and power plant alterations. $30,000 or more. Francis Eng. Co., Saginaw, engrs.

Mich., Morenci—Village, election Nov. 10, $146,000 bonds to secure P.W.A. loan and grant to construct municipal electric light and power plant and distribution system. G. C. Daily, Morenci, engr.

Mich., River Rouge—Ford Motor Co., Schaefer Rd., Dearborn, making plans 40x150 ft., brick, steel, rein.-con. factory and power house, concrete pile found., small hydo-electric unit to be installed for power, air conditioning equipment, included, insulated roof and ceiling, Newburg Rd. Giffels & Vallet, 604 Marquette Bldg., Detroit, egrs.

Minn., Fairfax—Municipality plans electric power plant. $60,000. G. M. Orr & Co., Baker Bldg., Minneapolis, engr. P.W.A. project.

Minn., North Mankato—City, E. M. Chales, clk., making plans constructing municipal electric light and power plant, incl. 45x82 ft. power house, distribution system. G. M. Orr & Co., 408 Baker Bldg., Minneapolis, engrs. Wick & Stansfield, North Mankato, archts.

Minn., Preston—Village, C. P. Grebin, clk., plans municipal electric power plant and distribution system. $46,000. $21,500 loan and grant allotted by P.W.A. G. M. Orr & Co., 408 Baker Bldg., Minneapolis, engrs.

Minn., St. Cloud—City defeated amendment to city charter to issue revenue bonds to construct municipal elctric power and distribution plant. $1,294,000. Burns & McDonnell, 107 West Linwood Blvd., Kansas City, Mo., engrs.

Mo., Marshall—City plans improving light plant and distribution system. Burns & McDonnell Eng. Co., 107 North Linwood Blvd., Kansas City, engrs.

Neb., Omaha — Creighton University, 25th and California Sts., plans by L. A. Daly, Insurance Bldg., constructing 2 new buildings, installing complete unit for distribution of electric light and power. To exceed $100,000.

N. M., White Oaks—New Mexico Power & Light Co., White Oaks, plans electric power plant. Est. about $100,000.

N. Y., Brooklyn—Dpt. Sanitation, Municipal Bldg., New York, plans by W. D. Binger, c/o owner, 1 story, 65x80 ft., brick power house, Knapp St. and Avenue Z, $44,000; 1 story, 44x444 ft., brick pump house with equipment, concrete found., Bragg St. and Avenue S. $28,000.

N. Y., Pine Aire Station—Bids Nov. 14 (extended date), by Dpt. Mental Hygiene, State Office Bldg., assembly hall, power house and service connections, at Pilgrim State Hospital.

N. Y., Webster — Rochester Gas & Electric Co., Rochester, plans electric plant and distribution system. Work by day labor and separate contract. Private plans. Public Service Comn. granted permit.

N. Y., Wellsville—Municipality, waterworks project and power plant. **Maturity indefinite.** $85,000. P.W.A. allotment rejected. E. J. Rowe, 110 Maple St., engr.

O., Cincinnati—Kroger Grocery & Baking Co., 35 East 7th St., plans by Tietig & Lee, 34 West 6th St., 1 story, brick, rein.-con. power house, plain found., State St. $150,000. Fosdick & Hilmer, Union Trust Bldg., engrs.

O., Cincinnati — Oliffrich Brewing Co., 242 West Micken St., plans by Fosdick & Hilmer, archt. and engr., Union Trust Bldg., power house for brewery. To exceed $40,000.

O., Dover—City plans improving municipal light and power plant. $330,000. Approved by Engineering Division of P.W.A.

Okla., Muskogee—Election Nov. 6, $1,260,000 bonds for municipal light plant.

Utah, Murray—City voted bond issue for installation of Diesel engine at hydro-electric plant in Little Cottonwood Canyon. Est. $33,000 P.W.A.

Va., Danville—Election Nov. 6, to vote on $2,225,000 bonds for power project held invalid. The court ruled a second election before the expiration of a year forbidden.

Wash., Seattle—Bids Nov. 8, by Bd. P. Wks., furnishing control and instrument switchboards, frequency and load control equipment for Diablo Power House for Skagit hydro-electric development. $35,000-$45,000. Bd. taking bids 413,000 lb. structural steel for Diablo transmission line towers.

Ont., Emo—Municipality plans construction electric lighting plant. $50,000.

Ont., Schreiber—E. J. Sheehan, Reeve, plans municipal light plant, est. $75,000. Interested in prices of meters, transformers, etc.

Que., Montreal—City plans sanitation plant to prevent pollution of Back River, $750,000; also erecting sewage pumping station, $1,250,000. I. E. Blanchard, dir. P. Wks.

Australia, Melbourne — Bids Nov. 21, by Victorian Railway Co., nine 1,500 volt contractors capable of carrying 750 ampere***Nov. 29, by Melbourne & Metropolitan Tramway Bd., traction sub-station units consisting of rotary converter, gears rectifier, steel tank type rectifier and automatic switchgear.

Italy, Suivania—Italian Government, Rome, plans constructing dam to impound 47,000,000 cu. meters of water and hydro-electric plant to supply current for Italian Railway System.

South Africa—South African Railways & Harbors Administration, Johannesburg, making plans erecting pre-cooling storage plant at Table Bay, $1,400,000; Bids Nov. 19, by T. H. Watermeyer, Johannesburg, South Africa Railway & Harbors Administration, pre-cooling plant at East London, $1,000,000.